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LIST OF CONTENTS.

January 17, 1905.

February 7, 1905.

February 21, 1905.

March 7, 1905.

March 21, 1905.

April 18, 1905.

ALPHABETICAL LIST

OF THE

CONTRIBUTORS,

With References to the several Articles contributed by each.

LIST OF PLATES.

1905.—Vol. I.

LIST OF TEXT-FIGURES.

1905.—Vol. I.

NEW GENERIC TERM

PROPOSED IN THE PRESENT VOLUME (1905, VOL. I).

ERRATUM.

Page 118, line 11 from bottom, *for* 243″ *read* $24\frac{3}{4}$″.

PROCEEDINGS

OF THE

GENERAL MEETINGS FOR SCIENTIFIC BUSINESS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.

1905, Vol. I. (January to April).

January 17, 1905.

G. A. Boulenger, Esq., F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions that had been made to the Society's Menagerie in December 1904:—

The registered additions to the Society's Menagerie during the month of December were 125 in number. Of these 47 were acquired by presentation, 3 by purchase, 29 were received on deposit, 5 were bred in the Gardens, and 41 were received in exchange. The total number of departures during the same period, by death and removals, was 163.

Amongst the additions special attention may be directed to:—

1. A young male Greater Koodoo (*Strepsiceros strepsiceros*) from Somaliland, presented by Major Irvine, I.M.S., on Dec. 12th.

2. A Hairy-eared Bear (*Ursus piscator*) from Manchuria, presented by Mr. Frederick Ringer on Dec. 13th.

3. Two Victoria Crowned Pigeons (*Goura victoriæ*) from Jobie Island, purchased on Dec. 15th.

4. A young specimen of Pousargue's Guenon (*Cercopithecus pousarguei*) from Northern Nigeria, presented by Mr. L. Lester on Dec. 29th. New to the Collection.

The Secretary exhibited an enlarged photograph, taken by Mr. H. Sandland and presented by him to the Society, of "Jim,"

the Indian Rhinoceros which had recently died in the Gardens after an existence there of forty-one years.

The following papers were read:—

1. Some Notes on the Cranial Osteology of the Mastigure Lizard, *Uromastix*. By Frank E. Beddard, M.A., F.R.S., Prosector to the Society.

[Received December 13, 1904.]

(Text-figures 1–4.)

During a recent examination of a number of Reptilian skulls, I noted some features in the palate, as well as in other regions of the skull, of *Uromastix spinipes* which are undoubtedly of some interest. The most recent papers on the skull of *Uromastix* with which I am acquainted are by Busch * and Siebenrock †. The former writer deals only with the palatal region and principally with the soft tissues of that region in the Lacertilia and in *Hatteria*. A number of dry skulls are also figured, and among them *Uromastix*, with which figure, however, my own observations do not agree completely. It must be remembered, however, that Dr. Busch and I had before us different species, he dealing with *Uromastix hardwickii* and I with *U. spinipes*. Whether age may have anything to do with these differences I do not know; but in any case the skull of *Uromastix spinipes*, upon which I report here, measures 43 mm. from the occipital condyle to the tip of the premaxillæ, which agrees pretty well, as do the other measurements of the body, with those given by Boulenger ‡ for this species, which is considerably larger than *Uromastix hardwickii*.

Dr. Busch describes the bony palate of *Uromastix* in the following way, and his figure corresponds with that description. The two pterygoids are divided by a suture from each corresponding palatine, which has a very oblique course. This results in the cutting off of a large piece of each palatine from approximation in the middle ventral line of the skull. In this there is a difference from the allied *Calotes* and *Iguana*, both figured by that author; in fact a dissimilarity from the Lacertilia in general. Inasmuch, however, as this is but a very slight exaggeration of the usual obliquity of this suture among the Agamidæ and some other lizards, the author of the paper to which I refer does not lay any stress upon it.

Dr. Siebenrock does not figure the skull of this genus; nor does

* "Beitrag zur Kenntniss der Gaumenbildung bei den Reptilien," Zool. Jahrb. (Abth. f. Anat.) xi. p. 441 (1898).

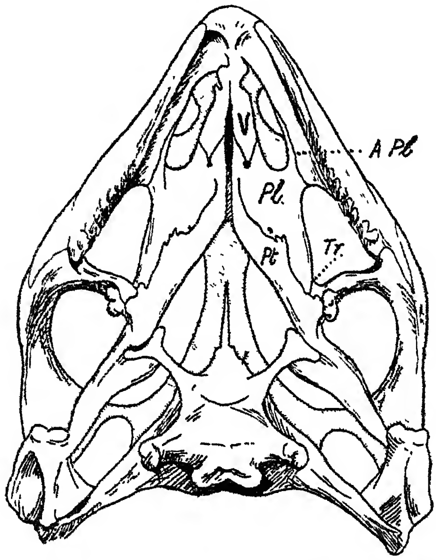
† "Das Skelet der Agamidæ," SB. k. Akad. Wiss. Wien, civ. p. 1112 (1895).

‡ Catalogue of Lizards in B. M. vol. i. p. 407 (1885).

he emphasise certain of the following points in the structure of the palate of *Uromastix spinipes.*

In the latter species (see text-fig. 1) the anatomy of the bony palate is somewhat different from that of *Uromastix hardwickii.* As Dr. Busch has mentioned in the case of the latter species, the pterygoids and palatines nowhere meet their fellows in the middle line; the palate is so far completely schizognathous. But while in *Uromastix hardwickii* the palatines might, so to speak, meet each other in the middle line in the way that occurs in many Lacertilia, this is rendered impossible in *Uromastix spinipes* by the forward growth of the pterygoids to reach, or very nearly reach,

Text fig. 1.



Ventral view of skull of *Uromastix spinipes.*

A.Pl., anterior bar of palatine; *Pl.*, palatine; *Pt.*, pterygoid; *Tr.*, transverse; *V.*, vomer.

the vomers. These bones (the pterygoids) are at first divided from the palatines by an oblique suture; this suture later becomes parallel with the long axis of the pterygoid itself, and only dies away anteriorly, close to, if not in actual contact with, the vomers. If the vomers of that lizard happened to be rather larger than they actually are in this species, and as they undoubtedly are in some lizards, there would be a prolongation forward of the pterygoids to the vomers. As it is, their forward growth results in the complete severance from each other of the palatines, except possibly for a very minute space anteriorly. These facts are to be noted in the accompanying figure (text-fig. 1).

I believe that this extension forwards of the pterygoids and subsequent cutting off of the palatines from forming the median portion of the hard palate is a new fact so far as concerns the Lacertilia. It is at any rate clear that the fact, if known and on record, has escaped general attention. For in the elaborate account of the development of the skeleton of *Hatteria* by Prof. Howes and Mr. Swinnerton *, the greater part of the "Introduction" is devoted to emphasising the characters of the palate in *Hatteria*, from which introduction I extract the following sentences, viz.:—"One of its (i. e. *Hatteria's*) most distinctive characters is the forward prolongation of the pterygoids to meet the vomers with apposition in the middle line. The mere forward prolongation referred to is a feature already recognisable among the Batrachia and Stegocephalia." The authors then proceed to refer to those reptiles and birds in which this forward prolongation with or without apposition occurs; but they mention no Lacertilian in which this state of affairs exists. It is plain therefore that it is meant to contrast *Hatteria* with Lizards in the arrangement of the bones of the palate.

I am thus able to record here a new (or at least little known and overlooked) morphological fact which has been held to be of considerable importance.

It would thus appear that the peculiarities of the palate of *Hatteria* as distinguishing that reptile from the Lacertilia have been somewhat overrated, of course through ignorance of the conditions which obtain in the lizard which forms the subject of the present communication to the Society. Apart altogether from the new facts contained in the present paper, the difference between *Hatteria* and the Lacertilia as regards the palate is not greater than between the Emu and a Rail, and is, indeed, almost exactly the same so far as the point under discussion is concerned. The analogy may now, it will be observed, be pushed still further. *Uromastix* is Lacertilian so far as its general anatomy is concerned, but shows in its palate a likeness to *Hatteria*, just as the Tinamou and some other birds † are carinate in most features but "struthious" in certain palatal arrangements. A "Rhynchocephalian" character of the bird palate, as Prof. Howes and Mr. Swinnerton term the thrusting forward of the pterygoids, has been shown to be transitory in some birds and subsequently lost through co-ossification. Whether this is the case with any true Lacertilia I am not aware.

It must not be understood that I am arguing for a special likeness between *Hatteria* and *Uromastix* among the Lacertilia. I am only urging that a character supposed to be peculiar to *Hatteria* as contrasted with the Lacertilia is not peculiar to that reptile but is found in a Lacertilian.

In regard to the palate there is another fact which requires

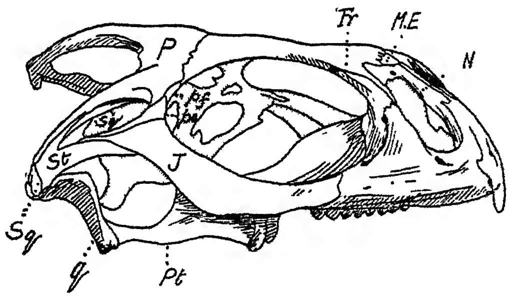
* "On the Development of the Skeleton of the Tuatera," Tr. Z. S. xvi. p. 2 (1901).

† See Pycraft, "Contributions to the Osteology of Birds," P. Z. S. 1898, p. 973.

attention. The junction of the palatine with the maxilla—the direct junction, not that through the transverse bone—is long and firm in *Hatteria*, a fact which, possibly, is correlated with the existence and position of the palatine teeth. Their groundwork is thus strengthened. As possibly comparable to this, it is interesting to note a slip of bone in *Uromastix* (text-fig. 1, *A.Pl.*, p. 3), continuous with and not segmented off from the palatine, which runs forward in close apposition to the maxilla. Among the immediate allies of *Uromastix*, e. g. *Amphibolurus*, *Iguana*, this process of the palatine is aborted. Finally (so far as concerns the palate), it is important to notice that the palatine bones have not merely the long forward extension that has been referred to, but that they also extend a long way back, reaching, indeed, the transverse bones on either side. This has been noted in *Uromastix*, and it exists also in some other Lizards, but it is not a universal feature of the Lacertilia. I mention the matter here in order to suggest that these two features are an indication of the partial retention of a formerly more extensive palatal bone such as persists in *Hatteria*.

I now turn to the consideration of certain points in the skull which do not appear to have been recorded, though I do not pretend that they bear upon the retention of any archaic characters.

Text-fig. 2.



Lateral view of the skull figured on p. 3.

Fr., frontal; *J.*, jugal; *M.E.*, mesethmoid; *N.*, nasal; *P.*, parietal; *q.*, quadrate; *pf.*, postfrontal; *po.*, postorbital; *Pt.*, pterygoid; *Sq.*, squamosal; *St.*, supratemporal.

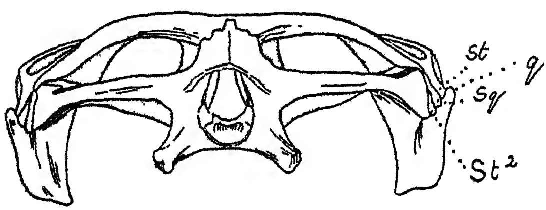
The orbital and postorbital regions offer some characters not without interest, and, as it appears to me, are not well known. Gegenbaur has figured and contrasted side views * of three Lacertilian skulls including *Uromastix* and *Iguana*. In the latter is correctly represented a large postorbital and a small postfrontal bone. I cannot, however, agree with Gegenbaur's figure of *Uromastix*—on the assumption, of course, that the species figured

* Vergleichende Anatomie der Wirbelthiere, vol. i. p. 391.

by him is *Uromastix spinipes*, or that in the particulars to be referred to there is no difference between *U. spinipes* and other species of the genus. In *Uromastix*, Gegenbaur figures a rather smaller postorbital than in *Iguana*, and represents the postfrontal of the latter lizard as absent. This interpretation of the bone bounding the orbit posteriorly and intervening between the jugal and the parietal is, I believe, correct; but, as will be seen from the annexed figure (text-fig. 2, p. 5), the postfrontal is not absent. The postfrontal is a very much smaller bone, both actually and relatively, than it is in a skull of *Iguana tuberculata* at my disposal. Furthermore, the postorbital in *Uromastix spinipes* has not the shape that it is represented to have in the drawing of Gegenbaur. It extends backwards along the jugal for a much greater distance, but does not, as is the case with the postorbital of *Iguana*, reach the squamosal.

The squamosal in *Uromastix spinipes* requires some consideration since it appears to differ greatly from that of the *Uromastix* figured by Gegenbaur, and, indeed, from the squamosal of other Agamid lizards. There is, however, a likeness to the conditions obtaining in *Iguana*, a fact which encourages me in adopting a different view. The bones in question are depicted in the accompanying drawing (text-fig. 2, p. 5). As in other Agamids, the squamosal is a bifid

Text-fig. 3.



Back view of the skull figured on p. 3.

*St.*2, second supratemporal; other lettering as in text-fig. 2.

bone, of which one limb is applied to the jugal and the other to the parietal. Posteriorly the squamosal is in contact with the quadrate and appears to be in contact also with the lateral process of the occipital. The whole of this bone is not however, as I think, to be regarded as squamosal. It is true that the examination of this region in the skull of some Lizards might lead to that inference. But in *Uromastix* (at any rate in *U. spinipes*) (text-fig. 3) the posterior undivided region of the bone in question is seen to be divided off by a suture, which is equally clear on both sides of the skull. The piece thus cut off from the supposed squamosal is in contact with the quadrate below and with a small bonelet laterally, to which reference will be made immediately, and which interposes between it and the lateral extension of the occipital.

That half of the supposed squamosal which is applied to the parietal rests upon a thin splinter of bone which is, I think, but am not quite certain, continuous beneath with the cut-off portion of the supposed squamosal. The latter therefore evidently consists of two quite separate parts, which are not distinguished in Gegenbaur's figure already referred to. The question is, what are these two bones? but, before attempting to answer it, we will consider the same region of the skull of *Iguana* which is figured (not very satisfactorily) in Bronn's 'Thierreichs'*. In that lizard (see text-fig. 4, B, p. 8) a rounded bone lies between the parietal, occipital, quadrate, and reputed squamosal. This bone may be the segmented-off portion of the squamosal complex in *Uromastix*, or it may be the tiny bone in the same lizard which lies (see text-fig. 4, C) closer to the occipital, and which must be a supratemporal. If we compare the arrangement of the bones in the squamosal region of *Uromastix* with that in *Lacerta* as figured by Parker †, it would seem that we have, as in that lizard, two supratemporal bones of unequal size: the smaller of these is that wedged in close to the occipital; the larger is the external bone overlapping the real squamosal and commonly termed squamosal. Parker observes ‡ that "in many kinds (of lizards) . . . . the first supratemporal is wanting, the second is constant." If by the latter half of this statement the constant presence of a separate second supratemporal is meant, I venture to disagree with Parker. It does, however, apparently exist commonly, and is figured, for example, in *Gerrhonotus* by Siebenrock §. I use the word "apparently" advisedly; for I am not yet convinced that the bone in question is not in reality, as I have already suggested, the squamosal.

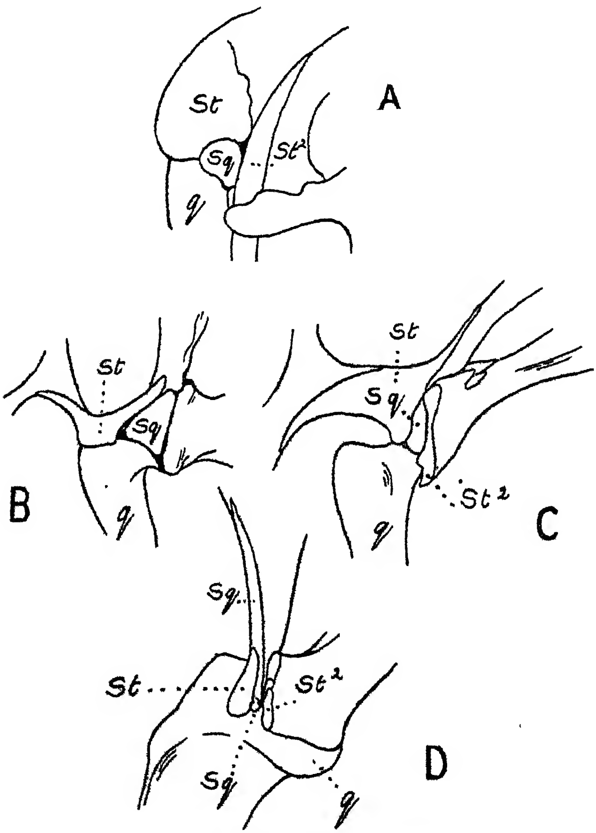
I may point out that the way in which I have ventured to interpret the bones of the region of the skull is quite in accord with Shufeldt's description of the skull of *Heloderma* ‖. In this lizard, Shufeldt describes as squamosal the bone which I have so named in *Uromastix spinipes*, and describes as a "fragment of the hinder end of the zygomatic arch" a rudiment which undoubtedly corresponds with the squamosal *multorum auctorum*. I detect in a specimen of *Heloderma* forming part of the collection in the Society's prosectorium (text-fig. 4, D, p. 8) a bony nodule lying between the occipital and the squamosal, which I identify with the second supratemporal of *Lacerta* and of *Uromastix spinipes*. Siebenrock ¶ has come to the same conclusion with regard to the bone that is in my opinion to be regarded as the true squamosal. But he terms that bone which I venture here to call supratemporal, "Paraquadratum." He does not appear to have seen

* Vol. vi. Reptilien, Taf. 68. f. 7.
† Phil. Trans. 1879, pl. 42. fig. iv.
‡ *Loc. cit.* p. 599.
§ "Zur Kenntniss d. Kopfskelet. d. Scincoiden," Ann. k.-k. Hofmus. Wien, vii. pl. xii. fig. 8.
‖ "Contributions to the Study of *Heloderma suspectum*," P. Z. S. 1890, p. 148.
¶ "Das Skelet der Agamidæ," SB. k. Akad. Wiss. Wien, civ. p. 1112.

in *Uromastix spinipes* the small bone which I term, following Parker, second supratemporal.

On the dorsal surface of the skull I desire to direct attention to three features. In the first place, the parietal foramen lies entirely in front of the fronto-parietal suture. Secondly, the

Text-fig. 4.



Squamosal region in various Lizards.

A. *Lacerta*. B. *Iguana*. C. *Uromastix*. D. *Heloderma*.
(Lettering as in text-figs. 2 & 3.)

unpaired frontal bone (text-fig. 2, p. 5) shows an unusual character, which is, however, approached in the Monitor. On each side, anteriorly, the bone sends a thin forwardly and outwardly directed process which passes between the prefrontal and nasal of each side and reaches the nasal vacuity.

In front of the frontal bone, between it and the nasals, is a squarish piece of bone distinct from both of these. In many Agamidæ there exists, according to Siebenrock, a fontanelle in this region, and the same occurs in *Iguana* and *Phrynosoma*. It is, however, according to Siebenrock, filled up in the full-grown lizard, and thus a character of youth. The plugging up of the vacuity by a separate bone in *Uromastix*, not mentioned by Siebenrock, leads me to the inference that this bone is to be looked upon not as a detached fragment of the frontal—a wormian bone, but as an ossified mesethmoid comparable to that which exists upon the surface of the skull in some Struthious birds, &c.

2. A Contribution to the Anatomy of the Frilled Lizard (*Chlamydosaurus kingi*) and some other *Agamidæ*. By Frank E. Beddard, M.A., F.R.S., Prosector to the Society.

[Received November 29, 1904.]

(Text-figures 5–10.)

Except for its muscular anatomy, which has been described by Mr. de Vis *, and for certain points in its osteology which have been described by Dr. Mivart † and Prof. Dollo ‡, the structure of the genus *Chlamydosaurus* appears to be but little known, though the external characters § and habits ‖ have been studied and recorded by many naturalists. The following pages contain a contribution to our knowledge of this Lizard as compared with allied genera among the Agamidæ, of which family it is undoubtedly to be reckoned a member.

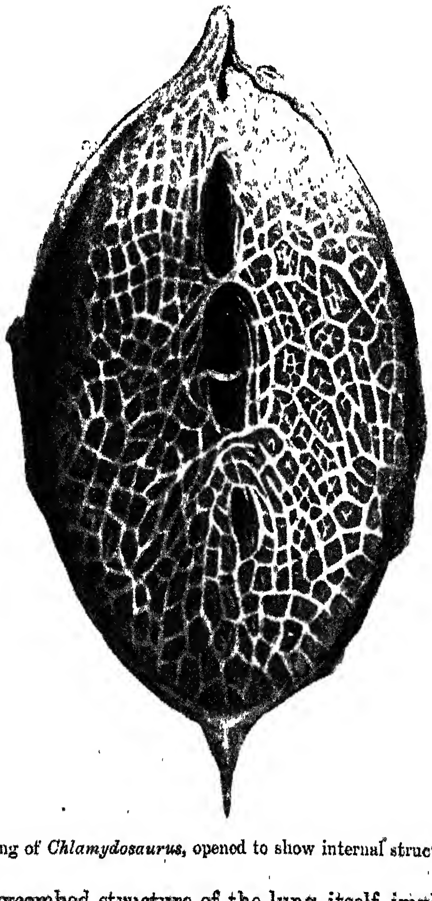
Lungs.—Seeing that the lungs of the Lacertilia are evidently capable of considerable variation ¶ and that the habits of *Chlamydosaurus* and *Physignathus* are very different, it is not remarkable that their lungs show certain differences of structure. They are, however, broadly similar and constructed upon a plan which characterises the family Agamidæ—to which these two genera belong—and the Iguanidæ. This is seen in the fact that the lung (both right and left) is divided into two non-communicating compartments, only communicating—that is to say—indirectly through each bronchus. The tip of each lung which is continued headwards beyond the bifurcation of the bronchi constitutes the second and smaller compartment of the lung. This, however,

* Proc. Linn. Soc. N. S. W. viii. 1883, p. 300.
† Article "Reptilia," Encycl. Brit. 9th ed.
‡ Rev. Quest. Sci. xix. p. 318.
§ Gray in King's Survey of Australia, ii. p. 424; Duméril and Bibron, Erpétol. Gén. p. 440; Boulenger, Brit. Mus. Cat.; Beddard, P. Z. S. 1904, vol. ii. p. 82, Encycl. Brit. 9th ed., Article "Lizard."
‖ Savile Kent, P. Z. S. 1895, p. 712.
¶ Milano, "Beiträge z. Kenntniss d. Reptilienlungen," Zool. Jahrb. (Abth. f. Anat.) vii. p. 545; he does not deal with either of the types described above.

does not, as it does in *Iguana*, overlap the larger compartment of the lung posteriorly. It ends exactly on a level with the entrance of the bronchus into the main division of the lung.

The interior of the lung in both genera is slightly sacculated, and the accompanying drawings (text-figs. 5, 6) illustrate the conditions obtaining in the two genera. It will be noticed that in *Chlamydosaurus* the dorsal sacculations, though fewer, are more pronounced and deeper than in *Physignathus*, while the

Text-fig. 5.



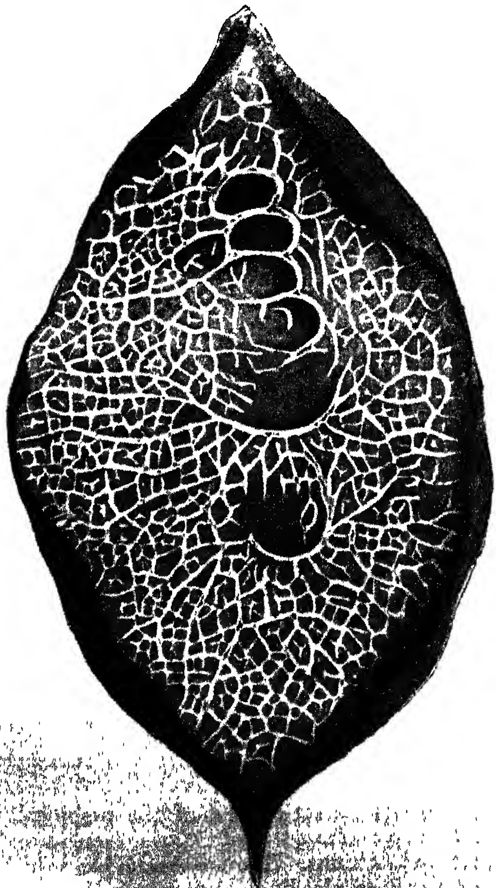
Lung of *Chlamydosaurus*, opened to show internal structure.

deeper honeycombed structure of the lung itself implies a larger respiratory surface and so far a greater efficiency as an organ of breathing. It appears to me to be a fair inference that this is associated with the bipedal and more active gait of *Chlamydosaurus*. In both genera the mesentery tying the lung to the

dorsal parietes extends to the very tip of that organ. It is not superfluous to direct attention to the fact, since the membrane in question is not always coextensive with the lung in Lizards.

Furthermore, in *Physignathus* the left lung, but not the right, has an attachment to the ventral body-wall by a mesentery extending for about half its length. I have also observed this ligament in *Agama colonorum*.

Text-fig. 6.

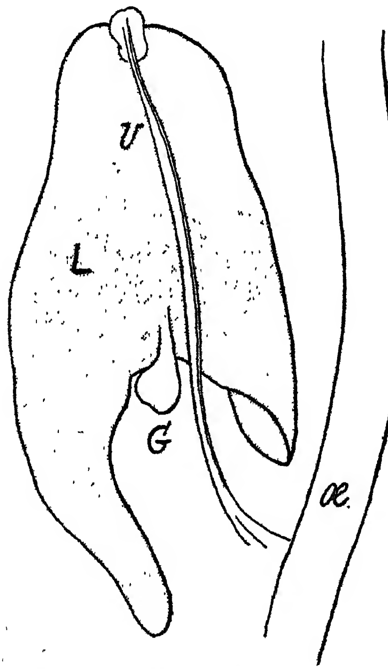


Lung of *Physignathus*, opened to show internal structure.

Liver.—The liver is bound down to the ventral parietes by a double umbilical ligament, the presence of which distinguishes *Chlamydosaurus* from *Uromastix*. In possessing this double

umbilical ligament, *Chlamydosaurus* differs from at least some others among the Agamidæ, but exactly agrees with *Varanus*, where also the two umbilical ligaments form a **V** when seen in transverse section: that is to say, the ligaments converge at their insertion on to the liver and diverge to be inserted separately on to the parietes. In the Skinks, on the other hand, the **V** is as it were upside down; the attachments of the ligaments to the liver are separate and wide apart, but they converge to be inserted on to the ventral parietes *.

Text-fig. 7.



Ventral view of liver of *Iguana*, to show relation of umbilical ligament.

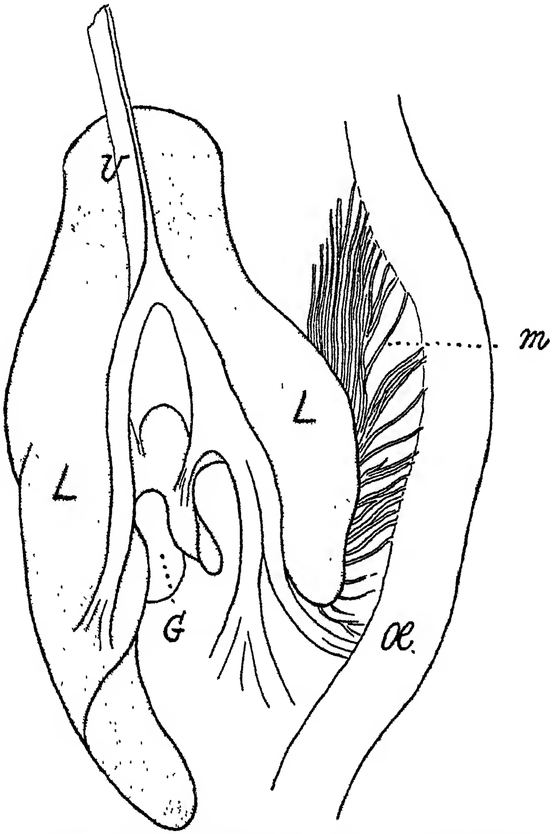
G., gall-bladder; *L.*, liver; *œ.*, œsophagus and stomach; *U.*, umbilical ligament.

In *Physignathus* the arrangement of the umbilical ligament (text-fig. 8, p. 13) departs from that of *Chlamydosaurus*, and is really more like that of the Skinks. The membrane has a double origin from the last third of the liver and anteriorly is single. The attachment to the ventral parietes is, however, single throughout. The umbilical ligament of this Lizard furthermore differs from

* See Beddard, "On Certain Points in the Visceral Anatomy of the Lacertilia, particularly of *Monitor*," P. Z. S. 1888, p. 98; and Cope, P. Acad. Sci. Phil. 1896, p. 308.

that of *Chlamydosaurus* in the strong development of muscular fibres in the posterior double region of the ligament. These fibres pass out on either side over the liver. That muscular fibres occur in the mesenteries of Saurians is of course a quite well-known fact, and is dealt with further on in this communication. That there should be this difference between allied

Text-fig. 8.



Ventral view of liver of *Physignathus*, to show relation of umbilical ligament. *m.*, muscular fibres in gastrohepatic ligament; other lettering as in text-fig. 7.

forms is not without interest. This double and muscular region of the umbilical ligament suggests a portion of the posthepatic septum of the Teiidæ*.

* Butler, P. Z. S. 1889, p. 466.

The umbilical ligaments of *Amphibolurus* are more like those of *Physignathus* than those of *Chlamydosaurus*; but the conditions observable are at the same time somewhat intermediate between those in the other two. The umbilical ligament divides, as in *Physignathus*, before the posterior end of the liver, but rather nearer to the end than in that genus. In *Chlamydosaurus* the conditions are not really different; it presents us merely with the third term in a series, for the umbilical ligament, as mentioned, arises as one sheet from the liver up to the very point of its bifurcation into two lobes; it then follows both, leaving the gall-bladder between. In *Physignathus* a tiny fragment is cut off each of the two lobes of the liver, and these lie between the tent-like folds of the posterior region of the umbilical ligament. Finally, in *Amphibolurus* a large piece of liver-substance belonging to the left lobe as well as a small piece belonging to the right lobe, in addition, of course, to the gall-bladder, lie sheltered by the posterior divided region of the umbilical ligament. As in *Chlamydosaurus*, no muscular layer passes out upon the liver.

It is plain, therefore, that in these characters *Chlamydosaurus* does not stand markedly apart from its allies. The liver, however, is rather more compressed and not quite so broad from side to side as in *Physignathus* and *Amphibolurus*, especially in *Amphibolurus*. In all these genera the long prolongation of the right lobe (the "Hohlvenenfortsatz" of Hochstetter) extends right down to the testis of its side of the body. There is no great length of vena cava left between testis and liver such as exists in some lizards, e. g. *Tiliqua*. In the Agamidæ, moreover, there is not always so marked a prolongation of the liver-lobe towards the gonad; for while in a ♀ *Agama colonorum* the liver-lobe was nearly in contact with the ovary, there was in a ♀ *Uromastix acanthinurus* a considerable stretch of vena cava between the two.

Mesenteries of Colon.—In *Uromastix acanthinurus*, which is a vegetable-feeder, the large intestine is particularly long, and the wide colon with thin greenish walls is sharply to be distinguished from the narrow thick-walled rectum. The whole of the colon and the greater part of the rectum lie outside of the shelter of the pelvic bones. In these particulars *Uromastix* contrasts with *Physignathus*.

Associated with this is a peculiarity in the arrangement of the mesenteries which is so far peculiar to the genus. In addition to the median dorsal mesentery tying down the gut to the parietes, the colon has a second mesentery which affixes it to the elongated process of the right lobe of the liver and to the vena cava behind the point where the lobe of the liver ends. This membrane forms the mesorectum at the beginning of the rectum, but it is distinct from it, as is shown by the fact that it is not pigmented, while the mesorectum is, and that its muscular fibres are more abundant and larger.

Muscular fibres in the Mesenteries.—The existence of muscular fibres in the mesenteries of Saurians is well known*. That they have not been recorded in the genera with which I deal in the present communication is less important to me than to note their distribution in those mesenteries.

The aorta in *Uromastix* lies between the two halves of the dorsal median mesentery, which are attached to it laterally and to the œsophagus above in the thoracic region of the body. The two mesenteries spring from the sides of the vertebræ ; they are much invaded by muscular fibres which have a dorso-ventral direction. The pulmonary mesenteries vary in this respect; those which bind each lung to the dorsal parietes are free from muscular fibres except towards their posterior region; on the other hand the (right) pulmo-hepatic ligament is much more invaded by muscular fibres. The mesogastrium and mesentery proper are not muscular, in which the former contrasts, as already pointed out, with the hepato-colic ligament. The oviducal mesenteries are very muscular. The umbilical ligament is also provided with muscular fibres. The gastro-hepatic membrane, on the other hand, is very slightly if at all muscular.

The three other genera which I compare with each other and with *Uromastix* show differences as to the amount of the invasion of the several mesenteries by muscular tissue. In considering the ligament which binds the liver to the ventral parietes (umbilical ligament) I have already referred to its partial muscularity in *Physignathus*. The muscles in question are very strong at their insertion on to the ventral body-wall; besides giving off fibres to the liver as already described, they give off other fibres which run along the gastro-hepatic ligament and pass out on to the œsophagus. There is no question here, it must be noted, of a muscular connection between the liver and the œsophagus and stomach. The fibres cross this membrane. Similarly the pulmo-hepatic ligament on the opposite side is traversed by muscular fibres, arising, however, in this case from the mesogastrium, which pass out on to both liver and lung. From this it results that the free extremity of the lung is attached by muscular fibres to the dorsal parietes behind the liver. The pulmonary ligament itself of this lung (the right), *i. e.* that which attaches the lung to the dorsal parietes, is completely free from muscle. In the case of the left lung, however, which possesses no pulmo-hepatic ligament, the pulmo-parietal ligament, though generally free of muscle, has a few slips at the very tip of the lung which may correspond physiologically with those of the right side, though their relation to the pulmonary ligament is different. The mesogastrium is also muscular; but the fibres by no means form such a thick dense mass as they do in *Chlamydosaurus*, which will be dealt with immediately. They are more sparsely scattered, with wider non-muscular intervals.

* Brücke, "Ueber ein in Peritonæum von *Psammosaurus griseus* aufgefundenes System von glatten Muskelfasern," SB. Wien. Akad. vii. p. 246.

These muscles are limited to the membrane of the stomach and œsophagus, and do not extend behind the extremity of the lungs. The bands of muscle vary in size.

In *Chlamydosaurus* there are some differences in detail from the conditions characteristic of *Physignathus*. The mesogastrium is much more distinctly double than the mesogastrium in *Physignathus*, owing to the greater size of the stomach, which lies across the dorsal middle liver, instead of to the left only. With this is associated not only the much more distinctly double character of the mesogastrium, but its much greater muscularity. The membranous intervals between the muscular strands are so much reduced, that each mesogastrium looks like a thin muscle of coarse texture.

I have already mentioned that the umbilical ligament is not muscular. If there are muscles in the pulmo-hepatic, pulmo-parietal, and gastro-hepatic ligaments, they must be microscopic. The mesentery proper has only muscular fibres at its very beginning, and these run at least chiefly to the stomach.

Amphibolurus is somewhat intermediate between *Physignathus* and *Chlamydosaurus*. There is some development of muscle in the umbilical ligament posteriorly, which for the most part passes out upon the gastro-hepatic ligament and ends in contact with the walls of the stomach, and not, so far as I can make out, upon the liver. The posterior end of the pulmo-hepatic ligament is similarly invaded by muscular strands. The mesogastrium is very distinctly muscular, but not so markedly as in *Chlamydosaurus*, though perhaps rather more so than in *Physignathus*.

That the Iguanidæ and the Agamidæ are very closely allied families is admitted. It is not therefore without importance to compare the conditions which obtain in *Iguana* in respect of the invasion of the mesenteries by muscular tissue. I have examined from this point of view two specimens of *Iguana tuberculata*, and find the following state of affairs:—The umbilical ligament is absolutely single and does not divide into two sheets posteriorly; it lies entirely to the left of the gall-bladder and contains no muscular fibres. The mesogastrium is invaded by a moderate amount of muscular tissue, but none of the other mesenteries that have been referred to in the foregoing account of various types of Agamidæ shows any such thick strands of invading muscular tissue in *Iguana* as they do in some of the Agamidæ. It seems likely therefore that this character will be of some use in framing descriptions of the several families of Lizards.

Some Arteries *in Uromastix* *.—The epigastric arteries originate in *Uromastix*, as in *Iguana*, from the subclavians. In the former genus, the artery pursues a rather complicated course before passing down the inside of the abdominal wall as the epigastric artery. The main branch of the subclavian traverses the sternal region and appears on the ventral surface of the sternum,

* See Calori, Mem. Ac. Bologna, 1862, p. 525, for other details of vascular system.

when it immediately gives off a branch to the pectoral muscles. After this the artery again perforates the body-wall close to a rib and reappears upon the peritoneal face of the ventral musculature, where it runs back and constitutes the epigastric. The conditions which obtain in this genus are not universal among the Lacertilia. The origin of the epigastric in *Monitor* is described by Corti * as being quite different. I can confirm this. It originates in the Monitor from the carotid artery before it divides into two, but still some way in front of the heart.

The relationship between the intercostal and œsophageal arteries is worth remarking upon in this Lizard. The left aorta is not, as it appears, concerned with the circulation of either the œsophagus or the body-wall †. But the right aortic arch gives off branches to both. There are two pairs of intercostals in front of the union of the two aortæ; both of them on the right side only give off a twig to the walls of the œsophagus. After, that is posteriorly to, the junction of the two aortæ, one trunk arises on each side of the aorta, which branches into an intercostal and an œsophageal branch. From this point backwards the branches to the alimentary canal arise separately from the intercostals. On the right side there are four of these arteries, on the left only two. There is not, therefore, an accurately paired arrangement.

It is noteworthy that the intercostal arteries ‡ do not plunge so deeply into the musculature of the back as they do in some Lizards; the arteries in question can be followed for a long distance towards the ventral extremities of the ribs, lying as they do very superficially in the musculature. In *Iguana*, on the other hand, the arteries in question are lost to view directly they touch the dorsal musculature on either side of the middle line.

It does not appear that the aorta gives off in the gastric region any branches to the liver; the hepatic artery, which is single, arises as a branch of the cœliac. It is important to remark this fact because in some Lizards there are such arteries. In *Lacerta galloti*, for example, each of the last two intercostal arteries which lie in the liver region gives off a branch to that organ, which branches lie close to the dorsal parieto-hepatic veins. In this particular *Iguana* agrees with *Uromastix*.

Skull.—The skull of *Chlamydosaurus* is much like that of its allies *Amphibolurus* and *Physignathus*. On the whole, it comes nearer to the former than to the latter, as the following facts tend to show. It has also peculiarities of its own. On a general aspect of the skulls the supratemporal fossa is seen to be very much more elongated in *Physignathus* than in the other two genera. This is actually due to the greater proportionate length of the median unpaired portion of the parietal in *Physignathus*. The relative lengths of the median portion of the parietal and the diverging

* 'De systemate vasorum *Psammosauri grisei*,' 1847.

† Calori, however, figures an œsophageal artery arising from the left aorta just at junction with the right, and no others on either right or left half arch.

‡ These arteries are deliberately not dealt with by Calori.

posterior limbs of that bone in the three types under consideration are :—

Physignathus	10 : 16
Chlamydosaurus	5 : 14
Amphibolurus	6 : 17

Chlamydosaurus and *Amphibolurus* are thus much closer together than either is to *Physignathus*.

The parietal foramen is quite different in the three types. In *Physignathus* it is very minute; in *Amphibolurus* it is large and longitudinally oval, and the suture between the frontal and parietal bones touches the foramen equatorially. In *Chlamydosaurus* the foramen lies much further back and is quite in the middle of the anterior median piece of the parietal bone; it is intermediate in size between the foramina of the other two types. The occipital region of the skull is much more depressed below the level of the posterior limbs of the parietal in *Physignathus* than in the two remaining genera.

Anteriorly the dorsal aspect of the skull shows differences in these Agamid Lizards. In both *Chlamydosaurus* and *Amphibolurus* the premaxillary bone extends back beyond the posterior level of the nostrils. In *Physignathus* the bone, which is broader than in the other two types, does not extend so far back as to the posterior boundary of the nostrils; it follows that more of the nostrils are bounded by the nasal bones in *Physignathus* than in its allies.

On the palatal aspect of the skull, *Chlamydosaurus* shows a peculiarity which is not shared by either *Amphibolurus* or *Physignathus*; that is, that the palatines fail to meet in the middle line except for a short space anteriorly. This is not a matter of deficient ossification, as is shown by the clear rounded margins which bound the area where the palatines *do* come into contact. There is no question, however, here of the pterygoids pushing their way in between the palatines and preventing the latter from articulation, such as I have recently called attention to in *Uromastix spinipes* *.

In none of these Lizards is there a distinctly separate postfrontal bone; nor can I detect between the occipital and the first supratemporal any rudiment of the second supratemporal.

In all three genera, as well as in *Uromastix*, the columella (epipterygoid) does reach the parietal bone above; inasmuch as this bone does not reach the parietal in *Iguana* (as noted by Shufeldt †) or *Phrynosoma*, it seems likely that this character will prove useful in distinguishing the two families Agamidæ and Iguanidæ.

In all three genera—*Chlamydosaurus*, *Amphibolurus*, and *Physignathus*—the quadrate is directed backwards. In *Iguana*, on the other hand, it is nearly straight, that is, at right angles

* *Suprà*, p. 3.

† "Contributions to the Study of *Heloderma*," P. Z. S. 1890, p. 222.

to the long axis of the skull. This character, though uniting the three Agamid genera mentioned, is of no use for differentiating the families Agamidæ and Iguanidæ; for in *Uromastix* and *Phrynosoma* this bone is directed forwards, as in *Varanus* and *Heloderma*.

The three genera furthermore agree (to differ from *Uromastix*) in the comparative shortness of the basipterygoid processes, from which results a less divergent course in the pterygoids themselves, and as a consequence a narrower skull. It is interesting to note that the Iguanidæ show a similar pair of contrasts. It is plain from Dr. Busch's figures *, as well as from skulls before me, that *Iguana* has short basipterygoid processes and that *Phrynosoma* has long ones.

Finally, *Chlamydosaurus*, *Physignathus*, and *Amphibolurus* possess a long process of the lower jaw behind the articular cavity which is not paralleled in *Uromastix*.

Hyoid.—The hyoid of *Chlamydosaurus* differs in a good many respects from that of *Physignathus* and *Amphibolurus*, as may be seen by a comparison of the accompanying figures (text-figs. 9, 10, pp. 20, 21). The basihyoid sends back no long basibranchial processes in either *Chlamydosaurus* or *Amphibolurus*, though there are faint rudiments of them in the former. In *Physignathus*, on the other hand, there are two long basibranchial processes, as in *Iguana* and *Anolis*. I imagine that the absence or presence of these long processes is related to the absence or presence of the "dewlap" in the forms under consideration.

In these three Lizards, as in others, the hyoid and branchial arches [*i. e.* the anterior and posterior cornua] articulate with each other as well as with the median copula at their insertion on to that. There is, however, a marked difference in the angles at which the hyoid and branchial lie with regard to each other.

In *Chlamydosaurus* the two visceral arches are at about right angles to each other where they join the copula: *Physignathus* is at the other extreme; the parts in question are nearly in the same straight line. In this particular *Amphibolurus* comes nearer to *Physignathus* than to *Chlamydosaurus*. The fact that in *Chlamydosaurus* the posterior cornua are much longer than the anterior cornua than in the other types, I put down to the frill in *Chlamydosaurus* which is supported by these posterior cornua.

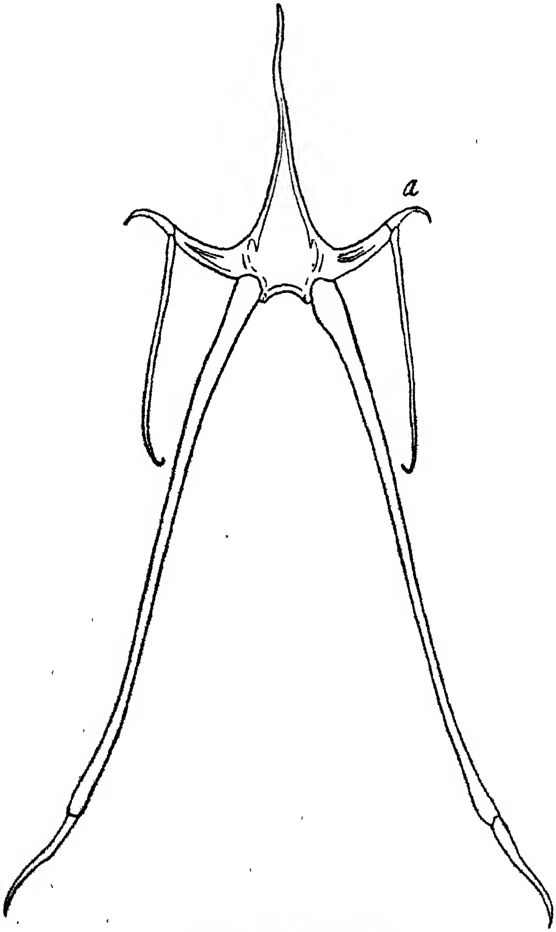
There is a final point to which I desire to direct attention which is of some little importance. In *Amphibolurus*, as in the majority of Lizards †, the backwardly and dorsally directed half of the hyoid arch is perfectly continuous with the extremity of the ventral bit of the arch that is attached to the copula. In both *Chlamydosaurus* and *Physignathus* the arrangement is as seen in the annexed figures (text-figs. 9, 10, pp. 20, 21), *i. e.* the ventral half is prolonged dorsally of the point of attachment to it of the

* "Beitrag z. Kenntniss d. Gaumenbildung bei den Reptilien," Zool. Jahrb. (Anat. Abth.) xi. pl. 35. fig. 7 *a*, and pl. 36. fig. 10 *a*.

† Bronn's 'Thierreichs,' Band vi. (Reptiles) pl. 72.

dorsal half of the hyoid. It appears to me that this projecting bit of cartilage (*a*) is the equivalent of the thickened region of the hyoid of *Lacerta* figured by Parker *. This projecting bit in

Text-fig. 9.



Hyoid of *Chlamydosaurus*.

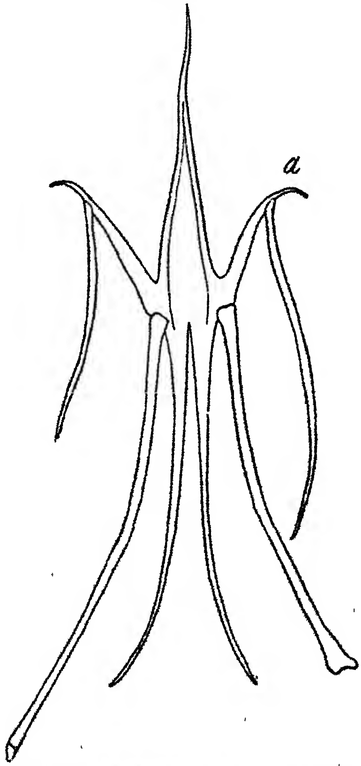
a, projecting cartilage of hyoid arch.

Chlamydosaurus is ossified and segmented off from the adjoining bones, with which it articulates by definite joints and is not merely continuous. If it could be shown that this piece does

* "On the Structure and Development of the Skull in the Lacertilia," Phil. Trans. 1879, pl. 40. fig. xi. and pl. 42. fig. v. In the latter figure the lettering "*ch.*" points to the thickening.

not in reality belong to the arch to which it is attached, but is a persisting fragment of the second postoral arch, we should be able to bring the Lacertilia into line with the Chelonia, where the true hyoid arch is small and is followed by two better developed branchial arches. At present, however, I can only make the suggestion, after recording the facts.

Text-fig. 10.



Hyoid of *Physignathus*. *a* as in text-fig. 9.

Vertebral Column and Ribs.—I find in *Chlamydosaurus* that there are 23 presacral vertebræ and 49 caudals; of the latter I am inclined to think that none are missing. Of *cervical vertebræ*, that is vertebræ entirely without ribs, I found in two individuals *five*, which is one or two more than the usual number. The last intercentrum of the anterior vertebræ lies between Nos. 6 and 7. The *dorso-lumbar* vertebræ *all* possess ribs, even the last of the series, which in the Agamidæ generally* does not bear free ribs.

* Siebenrock, "Das Skelet der Agamidæ," SB. k. Akad. Wiss. Wien, vol. civ.

The free ribs of the last dorso-lumbar were, however, present only upon one side. Four *ribs* reach the sternum on each side, of which the last pair are attached to the xiphisternum. The *sternum* shows the unusual character of being not fenestrated.

Between the first and second of the *caudal vertebræ* begin the intercentra. The first, however, are two small nodules only. The chevrons do not commence until the next vertebra. Towards the end of the series the chevrons are occasionally replaced by small nodules.

As regards the *shoulder-girdle*, I have only to remark that the clavicle arises from a point a little way down the scapula.

These facts may be supplemented by a comparison of them with the corresponding facts in the osteology of *Physignathus lesueuri*, a genus not investigated by Siebenrock in his extensive survey of the osteology of the Agamidæ.

The presacral vertebræ are 24. Of caudal vertebræ I counted 53, and am convinced that not more than one or two are missing.

The true cervical vertebræ are four instead of five, in which *Physignathus* agrees with two individuals out of three of *Amphibolurus barbatus* which I examined from this point of view. In the third specimen there was at least one rib on vertebra 4.

The spines of the dorsal vertebræ are much longer in *Physignathus* than in *Chlamydosaurus*, while they are still more depressed in *Amphibolurus*. The last intercentrum lies between vertebræ 5 and 6.

The ribs of *Physignathus* are in all 19 pairs, of which the fifth to the eighth pairs reach the sternum. The first two pairs show a peculiarity not observable in *Chlamydosaurus*. Each is expanded at its free end, this expansion being specially marked in the case of the second. The last of the sternal ribs is attached much nearer to the proximal end of the xiphisterna than is the corresponding rib of *Chlamydosaurus*. The sternum itself has in *Physignathus* the usual two foramina present in so many lizards. It is only the last of the dorso-lumbar series that has no free ribs.

3. A Note on the Brain of the Black Ape, *Cynopithecus niger*. By Frank E. Beddard, M.A., F.R.S., Prosector to the Society.

[Received November 29, 1904.]

(Text-figures 11 & 12.)

In a recent communication to this Society *, I described among a number of others the brain of *Cynopithecus niger*, the Celebesian Black Baboon. That brain is still in my possession and is that of a female. Since then I have been able to compare this brain

* P. Z. S. 1903, vol. i. p. 12.

with another, this time of a male and of about twice the size of the former brain. More exact measurements are as follows :—

	♀ brain.	♂ brain.
Length of hemispheres	63 mm.	83 mm.
Length of occipital lobe	10 mm.	24 mm.
Mesial end of fissure of Rolando to front end of brain	36 mm.	48 mm.
Greatest breadth of hemispheres	52 mm.	65 mm.

On again studying the smaller brain, I cannot find that my description and figures are inaccurate. There remain, so far as that brain is concerned, all the points of resemblance to *Semnopithecus* which I indicated in the paper which I have already referred to. The second brain is so strikingly different from the first, that it obviously occurred to me that error might have crept in. Instances of a confusion of labels and bottles are not unknown in Zoology. But a revision of the collection in the Prosectorium appears to disprove this.

The second brain, in fact, shows no resemblances to the *Semnopitheci* in any of the points in which the first brain undoubtedly does. As to the size, in the first place it is necessary to note that the smaller female brain was preserved in alcohol, the effect of which is to cause the brain to shrink and diminish in size; the larger brain, on the other hand, was preserved in formol, which swells out the brain.

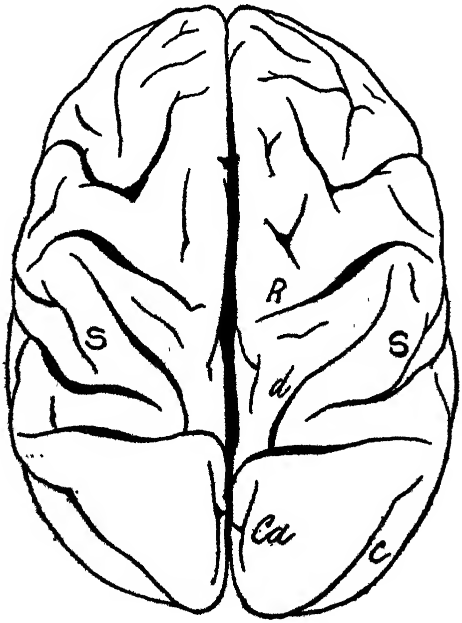
I found it impossible to refit this brain into the skull. Thus the difference in size between the two brains must be discounted on both sides. They are in reality more nearly equal than would appear from the above measurements. Nevertheless, there still remains a considerable difference, which must imply a difference in age, if not due to sex.

The brain upon which I report here is that of a nearly adult male. The permanent dentition is complete save for the last upper molars, which have not quite reached the level of the other teeth. The brain is quite like that of other Baboons. The occipital lobes are smooth above except for the lateral occipital fissure and for the front limb of the T-shaped calcarine fissure which appears upon the upper surface of the brain.

The inferior occipital sulcus is not small, as in the first described brain of this species; it is quite Macacine in extending right round to the posterior face of the occipital lobe. The collateral sulcus is concealed, as in Macaques, by the cerebellum. The inferior temporal sulcus is represented, as in Macaques, by a deep furrow at the lower end of the temporal lobe; there is also an upper piece which does not join the inferior occipital sulcus. The Sylvian fissure in this brain does join above (on the right side only) the parallel fissure; this is a common character in Macaques, but certainly rare in *Semnopitheci*. The original brain of *Cynopithecus* agreed in this particular with the *Semnopitheci*.

The intraparietal sulcus of brain No. 2 of *Cynopithecus* is precisely like that of a Macaque or a Baboon, in that it does not bend outwards before joining the Simian fissure; this intraparietal fissure does not reach the fissure of Rolando. The fissure of Rolando itself only cuts the inter-hemispheral sulcus on the right side of the brain. The median parieto-occipital sulcus in the brain of *Cynopithecus* which I describe here for the first time has a forward inclination as in the Macaques.

Text-fig. 11.



Brain of *Cynopithecus niger* (dorsal aspect).

c. Lateral occipital fissure; *Ca*. Calcarine fissure; *d*. Intraparietal fissure; *R*. Fissure of Rolando; *S*. Sylvian fissure.

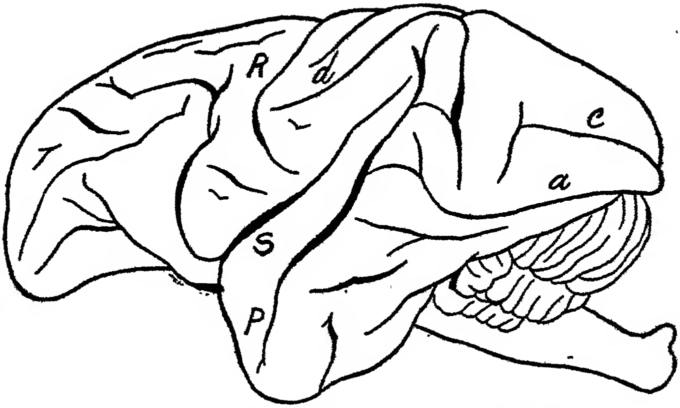
It will be observed, therefore, that in every feature in which the smaller brain of the female *Cynopithecus* differs from the Macacine and agrees with the Semnopithecine brain, a contradiction is shown in the larger brain of the male *Cynopithecus*. This latter brain, in short, is most emphatically a Baboon's brain; it belongs to the Macacine type.

The only certain conclusion to be drawn from these facts is that the brain of *Cynopithecus* may show all the typical Macacine characters. Though this is a conclusion which might be expected in view of the other zoological characters of the Celebesian

Baboon, it is nevertheless important to point it out, particularly so in view of the second brain, which may or may not invalidate the general applicability of the above statement as to the brain of *Cynopithecus*.

The question of course as to the second brain is, whether its differences are variations in an adult brain or are due to youth or sex, or both. This smaller ape only lived for six months in the Society's Gardens, and as there is no further evidence as to its age, it is impossible to be certain upon the point. I am disposed, however, to think that this small brain is comparatively undeveloped, and the differences which it shows from the larger brain would have lessened with age.

Text-fig. 12.



The same Brain as that represented in text-fig. 11 (lateral aspect).

a. Inferior occipital fissure; *P.* Parallel fissure.
Other lettering as in text-fig. 11.

These differences, it will be observed, can be mostly explained on that view. The simple calcarine fissure is simply minus the top bar of the T, which will ultimately appear; the Sylvian fissure has not yet grown sufficiently far back to meet the parallel fissure; the lower portion of the inferior temporal sulcus is undeveloped; a further growth forward of the operculum would alter the bending of the intraparietal fissure and perhaps shift forward the direction of the internal parieto-occipital. In fact, all the peculiarities of the smaller *Cynopithecus* brain may conceivably be explained on this view.

If this be correct, we can draw the interesting inference that the Semnopithecine brain is relatively to the Macacine at a lower level. If, on the other hand, the differences between the two brains are variations of completely adult structure, it is no longer

possible to draw a fixed line in brain-structure between the different groups of the Cercopithecidæ.

The above observations as to the adult brain are quite in accord with those of Zuckerkandl *, who, however, figures only the calcarine and adjacent fissures in a memoir which appeared about the same time as my own already referred to.

[I have just examined a third brain of *Cynopithecus* (a young female, which died on the 7th inst.), and find it like that of the male described above.—*March 9th*, 1905.]

4. On a Collection of Sipunculids made at Singapore and Malacca. By W. F. Lanchester, M.A., Assistant Lecturer and Demonstrator in Zoology in University College, Dundee †.

[Received November 1, 1904.]

During a joint expedition on the part of the late Mr. F. P. Bedford and myself to the Malayan region, I turned my attention in part to the collecting of Gephyrea. In the relatively limited area which we examined, it was perhaps not to be expected that much would be found in the way of species in this comparatively small group, but even allowing for this the results are distinctly disappointing. I have examples of only five species, belonging to three genera; in addition, I include another species from Borneo, a specimen of which Dr. Hanitsch, of the Raffles Museum, kindly handed over to me. All the specimens but one were obtained by digging in wet sand or ooze, in which they were very common; but many were rejected as being individuals of the same species as those already caught. This I now regard as a mistaken proceeding, and I would again urge on collectors that a great deal of interest is probably lost through following this method. More specialisation and less heterogeneous collecting seem the main desiderata nowadays.

In preserving specimens I found the method (recommended, I think, by Lo Bianco) of narcotising by pouring alcohol on sea-water to be very uncertain; and after two or three experiments decided on the use of fresh-water as a narcotising agent, afterwards preserving the animals in ½ per cent. chromic acid. I believe this method to be the best on the whole; though, seeing that even Sipunculids have their individual idiosyncracies (and the different effects of the same method on different individuals is most surprising), it is only the best as applied to an average number of specimens.

* "Zur Morphologie des Affengehirns," Zeitschr. Morph. u. Anthr. vi. 1903, pl. xii. fig. 16.

† Communicated by the SECRETARY.

I. Genus Sipunculus.

1. Sipunculus robustus Keferstein.

E. Selenka, Die Sipunculiden (Semper's Reisen, iv. p. 97).

Loc. Singapore. Teluk Ayer; two specimens. Pasir Panjang; two specimens.

The longitudinal muscles do not anastomose at all, and number 26–27, both in front and behind, in three dissected specimens. The ventral retractors arise in one instance from muscle-bands 1–5 on both sides, and in another instance from muscle-bands 2–5 on the right side, 2–6 on the left side; in all cases the outer origins are small, about half the size of the inner.

Colour in spirit, ash.

2. Sipunculus cumanensis Keferstein.

Selenka, *tom. cit.* p. 104.

Loc. Singapore. Pasir Panjang; several specimens of var. *opacus*, and three of var. *vitreus*.

In the specimens dissected I find the nerve-cord thickening anteriorly, the thickening beginning at the level of the ventral retractors, whence the cord gradually expands into a dorso-ventrally flattened band running up the introvert.

Among the specimens referred to var. *opacus* are several in which the hinder portion (or half) of the body presents the transparent colourless appearance of var. *vitreus*. In fully extended individuals a greater or less portion immediately behind the tentacles is also colourless or whitish.

The specimens all have 20 longitudinal muscle-bands, except one example of var. *vitreus* which has 26.

3. Sipunculus boholensis Semper.

Selenka, *tom. cit.* p. 109.

E coll. Hanitsch. Four specimens of this large species.

Loc. Gaya Island, British North Borneo.

Hab. Sandy shore, low water.

In the specimen dissected the longitudinal muscles number 31 or 33 in the front and mid-regions of the body, and only 30 in the hind part. The dorsal retractors arise each from four muscle-bands, the ventral from, on the left side two, and on the right side three bands.

II. Genus Phascolosoma.

4. Phascolosoma vulgare de Blainville.

Selenka, *tom. cit.* p. 20.

Loc. Singapore. Raffles Lighthouse, ooze under stones seven specimens. Pasir Panjang, muddy sand; one specimen.

The only difference I can discover between these individuals and Selenka's description of *Ph. vulgare* is that the ventral retractors arise at the anterior border of the posterior half of the body,

instead of at the anterior border of the middle third; in consequence of which the kidneys do not nearly reach to these origins.

The individual from Pasir Panjang was, in life, coloured orange, with the tip of the tail black.

5. PHASCOLOSOMA PELLUCIDUM Keferstein.

Selenka, *tom. cit.* p. 32.

Loc. Singapore. Pasir Panjang; one specimen.

Malacca. Pulau Jawi; two specimens, from under deep stones.

Selenka says in regard to the kidneys in this species: "Segmentalorgane von halber Körperlänge." Keferstein, on the other hand, says: "Segmentalorgane kurz"; and his figure accords with this description. These specimens agree with Keferstein's description in this respect; the kidneys are only one-sixth of the length of the body in the individual from Singapore, a little more than one-sixth in those from Malacca.

There are no hooks on the introvert in any of these examples, and in those from Malacca the retractors are notably thicker than in the Singapore specimen.

On the tails of these individuals (*i. e.* from both localities) is fixed a species of the Entoproctous Polyzoan *Loxosoma*, which Dr. Harmer has kindly undertaken to examine.

III. Genus PHYSCOSOMA.

6. PHYSCOSOMA SCOLOPS Sel. & de Man.

Selenka, *tom. cit.* p. 75.

Loc. Singapore. Raffles Lighthouse; two specimens. S'alat Sinki (strait between Pulau Brani and Blakang Mati), 5 fathoms, bottom of mud and stones; one small specimen.

In one example, the largest, the introvert is even longer than the body, being $1\frac{1}{8}$ times the length of the latter. As regards the longitudinal muscle-bands, there are only 17–19, instead of 20–21; the retractors, moreover, do not fuse till very far forward in the introvert.

5. The Marine Fauna of Zanzibar and British East Africa, from Collections made by Cyril Crossland in the Years 1901 and 1902.—*Gephyrea*. By W. F. LANCHESTER, M.A., Assistant Lecturer and Demonstrator in Zoology in University College, Dundee *.

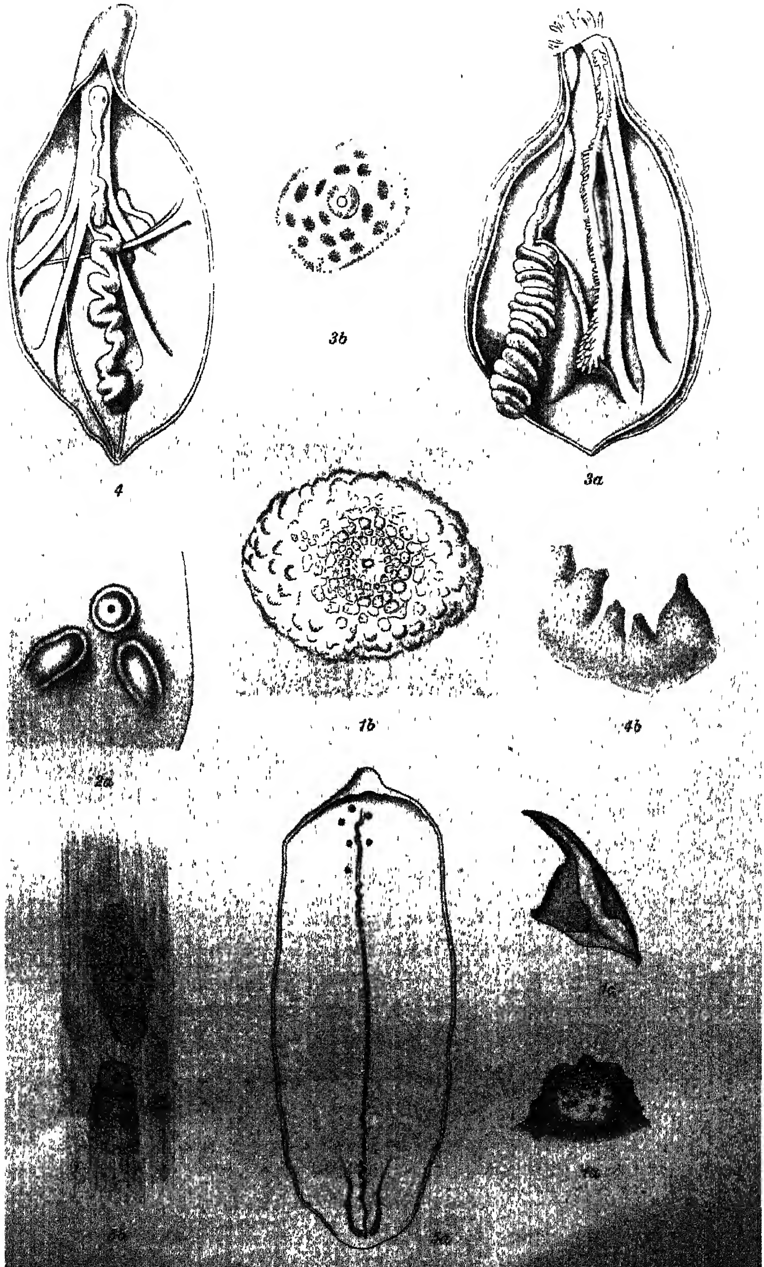
[Received November 1, 1904.]

(Plate I.†)

This collection was made by Mr. Crossland in East Africa during the years 1901–1902; it includes in all examples of 20 species,

* Communicated by the SECRETARY.

† For explanation of the Plate see p. 35.



4
3b
3a
2a
1b
4b

16 being Sipunculids and 4 Echiurids. Of the Sipunculids three, and of the Echiurids one, are new; the latter, a *Thalassema*, presents the novel feature of four pairs of nephridia, the greatest number hitherto met with in that genus. Unfortunately the Echiurids are not at all well preserved, and it is evident that the preservation of these animals needs even more careful attention than in the case of the Sipunculids. In this group, moreover, I notice that, whether due to contraction or otherwise, the nephridia and anal trees are apt to lose their characteristic appearance, the nephridia appearing small or even absent, and the anal trees simple in a species in which they are really dendritic.

SIPUNCULIDA.

I. Genus SIPUNCULUS.

1. SIPUNCULUS INDICUS Peters.

Arch. f. Anat. u. Phys. p. 382 (1850).

Loc. Pemba Island.

Hab. From the eastern reefs in sand near the shore.

Two large specimens, the internal organs of which are not sufficiently well preserved to enable me to add anything to our knowledge of their general anatomy.

2. SIPUNCULUS EDULIS Lamarck.

Sluiter, Natuurk. Tijds. Nederl. Ind. xlv. p. 484 (1886).

Loc. Chwaka Bay, Zanzibar.

Hab. Shore at low tide.

Several examples; in one of which the transverse dissepiments are absent.

3. SIPUNCULUS CUMANENSIS Kef.

Selenka, Die Sipunculiden (Semper's Reisen, iv. p. 104).

Loc. Chwaka Bay, Zanzibar.

Three specimens corresponding with Grube's var. *semirugosus.*

Loc. Zanzibar.

Two specimens of var. *vitreus.*

4. SIPUNCULUS TITUBANS Sel. & Bülow.

Selenka, *tom. cit.* p. 57.

Loc. Chwaka Bay, Zanzibar; two large specimens.

This is a very clearly defined species, and these specimens agree closely with the description. The only comment I have to make on the original account is that, so far at least as concerns these examples, the papillæ on the introvert, though certainly "von dreieckiger Form," are not so obviously so as in the case of *S. indicus*: the angles are rather softened down. This character together with the relative positions of the nephridial and anal

openings serve to clearly distinguish it, externally, from the latter species, to which it appears at first sight very similar.

This species, originally known from America, has also been described by Fischer from Madagascar.

5. SIPUNCULUS BILLITONENSIS Sluiter.

Natuurk. Tijdschr. Ned. Ind. xlv. p. 487.

Loc. Pemba Island.

Hab. From eastern reefs in sand near the shore.

One specimen.

6. SIPUNCULUS AUSTRALIS Kef.

Selenka, *tom. cit.* p. 90.

Loc. Chwaka Bay, Zanzibar.

One specimen.

This specimen, a large one, agrees in all features with Selenka's description, but is without any hooks on the introvert. The presence of hook-bearing individuals in species that normally possess no hooks has already been recorded, but I am not aware of an instance being known of the opposite phenomenon. That some of the hooks may drop off is, however, recognised, and it would seem that we have here the same occurrence carried to completion, owing either to age or causes that cannot be definitely specified. Of course we may be dealing with a case of local variation, but of this there is no evidence.

II. Genus PHYSCOSOMA.

7. PHYSCOSOMA SCOLOPS Sel. & de Man.

Selenka, *tom. cit.* pp. 75–76.

Loc. British East Africa.

Hab. Among coral at low tide; 2 specimens. Muddy shore at low tide; 1 specimen. 10 fathoms; 4 specimens.

Loc. Chwaka Bay, Zanzibar; 1 specimen.

These individuals correspond with the variety *mossambicense* of Selenka and de Man, in which the dark lines bordering the clear spaces in the hooks are curved and not bent at an angle. The accessory process varies, in the hooks of an individual, from being present as a distinct small *tooth* through intermediate stages to complete absence.

8. PHYSCOSOMA NIGRESCENS Kef.

Selenka, *tom. cit.* p. 72.

Loc. Zanzibar Channel, 5 fathoms.

One specimen in which, as in Selenka's Mauritius form, the papillæ on the base of the introvert are slightly larger than those on the body, and the hooks slightly different.

Loc. Chwaka Bay.

One large specimen. The longitudinal muscles do not anastomose immediately in front of the anus, but extend a little distance up the introvert. Hooks typical.

9. PHYSCOSOMA EVISCERATUM, sp. nov. (Plate I. fig. 1.)

Loc. Chwaka, Zanzibar.

There is only a single specimen present, in which all the internal organs, including even the muscle-layers, have entirely disappeared. The part of the introvert that bears the tentacles is also broken away. But the hooks and papillæ present features which prevent me from placing the specimen in any known species.

The introvert is as long as, or a little longer than, the body; it is not possible exactly to mark the limit between the two, so that perhaps, roughly speaking, it is better to describe them as equal in length, the introvert being at any rate not shorter than the body. Both are covered entirely, except for a small piece at the extreme anterior end of the introvert, with large conical papillæ, which are largest at the extreme hind end and smallest in the middle of the body; generally colourless, at irregular intervals over the body a single papilla appears dark-brown and very distinct as against its surroundings. The appearance of the papillæ under the microscope is shown in Pl. I. figs. 1 *a* & 1 *b*; those from the hind end are characteristically raised, in their basal regions, into small secondary papillæ.

The rows of hooks are numerous. In the region behind the mouth I find 15 rows (but these may in reality be more numerous, allowing for the tearing above mentioned); then comes a narrow interval, and again some 15 rows of hooks, and then after a similar interval 30 rows. All the hooks are alike in structure; fig. 1 *c* gives a representation of one, and the characteristic feature to which I wish to draw attention is the presence of a distinct process projecting from the dark curved line bounding the convex border of the light central area and encroaching on the latter.

Finally the body, which is markedly broader than the introvert, is unpigmented save for the isolated papillæ mentioned above; while the introvert is more or less brown, the coloration tending to be concentrated along a line that is probably either mid-dorsal or mid-ventral; only the narrow areas which separate the three areas of hooks are whitish.

III. Genus PHASCOLOSOMA.

10. PHASCOLOSOMA SEMPERI Sel. & de Man.

Selenka, *tom. cit.* p. 37.

Loc. Chwaka Bay; two specimens.

On one of these Mr. Crossland has the following note: "Opaque white skin like fine sand-paper in appearance."

11. PHASCOLOSOMA VULGARE Blainv., var. nov. SELENKÆ. (Plate I. fig. 2.)

Cf. Selenka, *tom. cit.* p. 23 (1883); and var. *tropicum* Sluiter, Siboga-Exp. p. 33 (1902).

Loc. British East Africa, 10 fathoms; 2 specimens, small. Chwaka, Zanzibar; 2 specimens, large.

These individuals evidently correspond with a form described by Selenka from the Red Sea, which differed from the type in the following particulars: the papillæ on the hind end were a little shorter and thicker, the hooks a little shorter, and the ventral retractors tending to be inserted a little more posteriorly. Selenka was unwilling to establish a variety on a single specimen, but it would seem better, now that we have these additions, to distinguish the form as a variety. The papillæ on the introvert are exactly similar to those on the hind end of the body; but even shorter and broader. I figure these, and one of the hooks (*v.* figs. 2 *a*, 2 *b*).

12. PHASCOLOSOMA GLAUCUM, sp. nov. (Plate I. fig. 3.)

Loc. Zanzibar Channel, 10–15 fathoms.

In this species, which is represented by a single specimen, there are no hooks, and only two retractors. The muscle-layers are so loosely attached to the skin that they readily tear away from it on opening the animal; the retractors themselves arise, as strands obviously split off from the longitudinal layer of the muscle-system, from the anterior border of the hinder quarter of the body, and meet each other round the œsophagus at the level of the base of the introvert. The body is 13 mm. (approximately) in length, the introvert 5 mm. only; the latter has a slightly darker tinge, owing to the crowding together of the pigmented papillate bodies, which are very low and not visible to the unaided eye, but distinctly so with the lens, under which they appear as distinct black spots. The papillæ on the body are visible under the lens as distinct clear spots; under the microscope they appear as elongated bodies with a clear apical opening and carried on fields roughly oblong in shape.

Internally, we find the œsophagus running back with the retractors as far as their insertion, and then bending sharply forward for a little distance before entering the intestine; the latter contains about 16 spiral turns, and is not attached to the hind end of the body. The rectum is without a diverticulum, and opens by the anus just behind the level of the base of the introvert. Two muscle-strands support the intestine anteriorly, and two more, arising from close to the nerve-cord on each side of it, support the œsophagus at the angle where it bends forward. There is a contractile vessel, thickly beset with little diverticula, along the length of the œsophagus where it lies between the retractors. The nephridia are colourless, and open just in front of the level of the anus.

13. PHASCOLOSOMA WASINI, sp. nov. (Plate I. fig. 4.)

Loc. Wasin, British East Africa; 10 fathoms.

Six specimens, of which the largest is 15 mm. in length. The most characteristic feature of this species is the numerous rows of

hooks of the *Physcosoma* type that lie in the introvert. Generally the hooks in *Phascolosoma* are simple, slightly curved structures, and in only one other form, the *Ph. papilliferum* of Keferstein (=*Ph. dissors* Sel. & de Man), do the hooks, so far as I know, acquire the features that are generally found in those of a *Physcosoma*, namely the greatly curved apex borne on a broad base, the more or less sharply differentiated clear central space, and often an accessory lobe. As regards the internal anatomy, the following are the most important features:—There are four retractors, of which the ventral arise fairly close to the nerve-cord and just behind, the dorsal just in front of, the middle of the body; these unite very soon to enclose the œsophagus, above which lies the simple contractile vessel. The intestine is not much twisted, and the rectum, which is moderately long, opens a little in front of the origin of the dorsal retractors; a little in front of the anal opening again are the openings of the nephridia, which latter are short, rather broad, and unpigmented. The intestine is held to the hind end of the body by a fine muscle-strand, and two other somewhat stouter strands run (*a*) from the left side of the nerve-cord to the commencement of the intestine, and (*b*) from near the anus, along the rectum, to the intestine. Two very distinct eye-spots may be seen just above the mouth.

Externally the body is covered with numerous, conical, often brown-coloured papillæ; in the middle, however, these are lower, less numerous, and more finger-shaped. These papillæ, moreover, extend a little way up the introvert, gradually becoming fewer and lower, till they reach the rows of hooks (which reach more than halfway back along the introvert); in between the rows they appear as flattened elliptical bodies with a conspicuous central opening.

IV. Genus Cloeosiphon.

14. Cloeosiphon aspergillum Quatrefages.

Selenka, *tom. cit.* p. 126 (1883).

Loc. Chwaka Bay, Zanzibar; 2 specimens. British East Africa; 1 specimen.

V. Genus Aspidosiphon.

15. Aspidosiphon elegans Cham. & Eysenh.

Selenka, *tom. cit.* p. 124 (1883); Sluiter, Natuurk. Tijdschr. Ned. Ind. l. p. 116 (1890), and Siboga-Exp. p. 19 (1902).

Loc. Wasin, British East Africa.

Hab. Among coral, at low tide.

Several specimens. In Selenka's key to the species of this genus he includes *A. elegans* amongst those in which the anal shield is calcified. But there is certainly no calcification in the specimens I have seen, nor does Selenka mention the fact in his description.

16. ASPIDOSIPHON TRUNCATUS, Kef.

Selenka, *tom. cit.* p. 118 (1883); Sluiter, Siboga-Exp. p. 17 (1902).

Loc. Wasin, British East Africa; 10 fathoms. One very small specimen.

ECHIURIDA.

VI. Genus THALASSEMA.

17. THALASSEMA BARONII Greeff.

Greeff, Die Echiuren, Nov. Act. Acad. N. Cur. xli. p. 151, pl. vi. fig. 64 (1879).

Loc. Zanzibar Channel.

Hab. Shore, above lowest tide-level.

The anal trees appear simple and not dendritic in this single specimen, as they do also in at least two among those collected by Dr. Willey. This character, together with the lack of any traces of the nephridia (which I cannot find either in this or in one of Dr. Willey's specimens), I take to be due to the fact that the individuals in question may be young. There is also a small globular diverticulum on the dorsal side of the rectum in this species.

Mr. Crossland has a note on the colour of this specimen to the following effect: "Crimson-lake colour, with light-green proboscis." Previous descriptions of the colours in this species give them as being dark-green in the body with violet stripes. Evidently, then, the colour-character is not necessarily constant, for, despite the absence of nephridia, I feel no doubt as to the correctness of my diagnosis on anatomical grounds, especially after comparing them with the specimens from Dr. Willey's collection.

18. THALASSEMA MOEBII Greeff.

Greeff, *tom. cit.* p. 152.

Loc. Chwaka Bay. Kokotoni Bay.

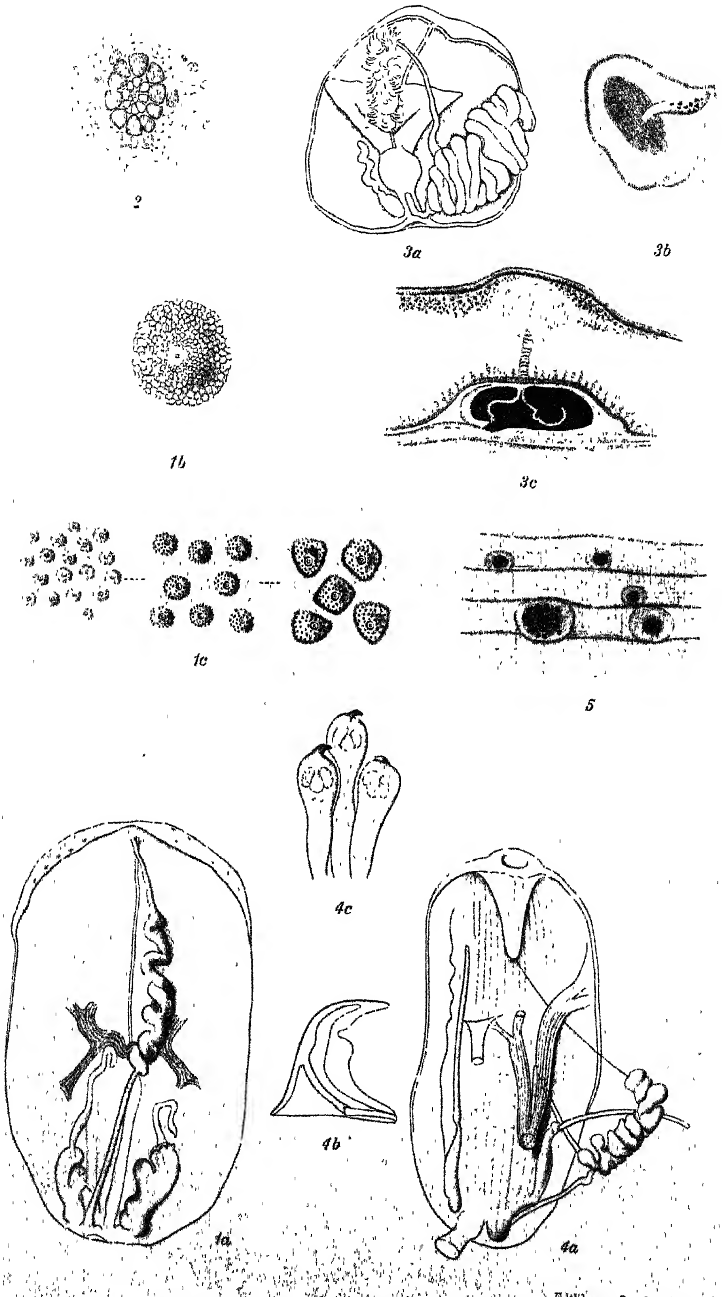
Hab. In sand in sheltered bays like the above.

Two specimens, on which Mr. Crossland has the accompanying note:—"Abundant in sheltered bays in sand above low-tide level, but extremely difficult to secure, as the burrows extend into crevices in the rocks below the sand. The larger specimens I never succeeded in obtaining. They occur with proboscides a foot or more long" (this presumably refers to those of large size) "when lying extended on the sand. Colour pink, owing to cœlomic fluid seen through skin. Proboscis cream-coloured and more opaque."

19. THALASSEMA sp.?

Loc. Chwaka, Zanzibar.

A single specimen in a very bad state of preservation. It is impossible to refer this specimen with any certainty to any known



E Wilson, Cambridge.

GEPHYREA FROM THE MALAY PENINSULA.

species, though it might possibly be referable to *Th. pellucidum* Fischer, which is, however, a Western form.

The muscles number 12 or 13, but some of them are so indistinct as to make it impossible to be quite certain. The anal trees are quite short, brown, tapering, and simple. No other internal features can be made out. The proboscis is 10 mm. in length as compared with a body length of 40 mm., and in this agrees with Fischer's species (*cf.* Shipley, Willey's Zool. Res. part iii. p. 351).

Each ventral hook has an accessory hook of about the same size lying close to it.

20. Thalassema decameron, sp. nov. (Plate I. fig. 5.)

Loc. Chwaka, Zanzibar.

Hab. In sand.

One specimen.

This species is characterised by the presence of four pairs of nephridia, which are, however, small in this individual and only slightly elongated. Two of them, moderately distant from each other, lie behind the setæ; and the other two, much closer together, in front of the setæ.

The body-wall is extremely thin; internally it is possible to distinguish ten, fairly broad, but inconspicuous, longitudinal muscles, which can also be seen from the outside shining through the skin. The anal trees are long, broad and brown at the base, but soon tapering and becoming transparent; simple and not dendritic in this individual.

EXPLANATION OF PLATE I.

Fig. 1. *Physcosoma evisceratum* (p. 31). *a.* Papilla from the front end of the body. *b.* Papilla from the hind end of the body. *c.* Hook.

Fig. 2. *Phascolosoma vulgare*, var. *selenkæ* (p. 31). *a.* Papilla from the introvert. *b.* Hook.

Fig. 3. *Phascolosoma glaucum* (p. 32). *a.* Dissection showing internal anatomy. *b.* Papilla from the front end of the introvert.

Fig. 4. *Phascolosoma wasini* (p. 32). *a.* Dissection showing internal anatomy. *b.* Papillæ from introvert.

Fig. 5. *Thalassema decameron* (p. 35). *a.* Body laid open, to show nephridia, muscles, and anal trees. *b.* Skin from mid-body.

6. On the Sipunculids and Echiurids collected during the "Skeat" Expedition to the Malay Peninsula. By W. F. Lanchester, M.A., Assistant Lecturer and Demonstrator in Zoology in University College, Dundee*.

[Received November 1, 1904.]

(Plate II.†)

This collection, which Mr. Shipley kindly put into my hands for determination, contains 12 species of Sipunculids and 1 of Echiurids; the latter is a new form, as are also four of the

* Communicated by the Secretary.

† For explanation of the Plate, see p. 41.

Sipunculids. I will do no more here than call attention to the discovery of an Eastern form (= *Physcosoma gaudens*, nov.) corresponding rather closely to the Western *Ph. weldonii*, and to the somewhat curious position of the anus in the new form *Phascolosoma pyriformis*.

Sipunculida.

I. Genus Sipunculus.

1. Sipunculus cumanensis Kef.

Selenka, Die Sipunculiden (Semper's Reisen, p. 104).

Loc. Penang.

Two specimens of the variety *opacus*.

The bodies of these two individuals are much longer, relatively to the introvert, than was stated by Selenka, who wrote "Rüssel ungefähr ein Drittel der Körperlänge": here, however, the introvert is only one-sixth of the body-length. The measurements for the two specimens are:—

(*a*) Introvert 43 mm., body 253 mm.
(*b*) „ 28 mm., „ 150 mm.

Probably this difference is due to the different relative contraction of the two parts of the animal in these as opposed to Selenka's specimens.

2. Sipunculus australis Kef.

Selenka, *tom. cit.* p. 90.

Loc. Pulau Bidan, Penang.

Two specimens.

In the one specimen dissected the ventral retractors arise from three, instead of four or five, muscle-bands, those three being the first to the third on each side of the nerve-cord.

II. Genus Physcosoma.

3. Physcosoma scolops Sel. & de Man.

Selenka, *tom. cit.* p. 75.

Loc. Pulau Bidan, Penang.

Numerous individuals.

In several of these specimens the skin is less transparent, so that the longitudinal muscle-bands do not shine through it; gradations may be traced, in others, between this and the typical transparent form.

4. Physcosoma nigrescens Kef.

Selenka, *tom. cit.* p. 72.

Loc. Pulau Bidan, Penang.

Three large, and one very small, specimens.

5. PHYSCOSOMA LURCO Sel. & de Man.

Selenka, *tom. cit.* p. 61.

Loc. Trengganu.

Numerous examples.

In the text Selenka speaks of "zwei vorderen Retractoren," but in the figure he shows them as arising in the same transverse line; in these specimens the dorsal retractors arise behind the ventral in the same longitudinal line, and so from the same muscle-bands, namely the first and second. Moreover, according to Selenka's figure, the four retractors fuse, after a short course, to form two retractors, and these two, again after a short course, again fuse to form one; here, however, the four retractors fuse immediately into one after a short course. Further, I may mention that the anus is not necessarily conspicuous as described by Selenka. In many cases it is quite indistinguishable; in many others it appears as a rather sunken cleft-formed opening, and in only a few cases as a round opening raised on a high papilla. As in the case of *Sip. cumanensis*, this difference of detail may be explained, without doubt, by the differing states of contraction in the various examples, either of the animal as a whole or of the anal sphincter or of both.

6. PHYSCOSOMA SOCIUM, sp. nov. (Plate II. fig. 1.)

Loc. Pulau Bidan, Penang.

Three specimens.

Introvert nearly half as long as the body and thickly covered, especially in front, with flattened dark papillæ, which posteriorly become more conical, smaller, lighter in colour, and less densely crowded. Those on the extreme hind end of the body are very like those on the front of the introvert, but over the body generally they are much more widely scattered, appearing as brown spots against the paler background of the semitransparent skin. These papillæ are formed of numerous concentric plates, and very closely resemble those of *Ph. psaron* Sluiter (*v.* fig. 1 *b*). There are no hooks on the introvert. The longitudinal muscles number 18–21 in the middle of the body, with occasional anastomoses; close to the posterior end there is a distinct convex line along which they again anastomose slightly, so that behind this line there are relatively fewer muscles. The four retractors fuse as soon as they meet; the ventral pair arise just behind the middle of the body from muscles 2–6, the dorsal just in front of the middle of the body from the 5th–6th muscles. The contractile vessel is without diverticula. The intestine has few (about 8–10) spirals; it is held to the posterior end of the body by the spindle-muscle and anteriorly by two strands inserted to the left of the nerve-cord; the rectum is long and opens near the base of the introvert. The nephridia are attached for two-thirds of their length, which is about half that of the body; their anterior halves are much swollen and their openings lie just behind the level of the anus.

Examination under the microscope of the skin of the introvert shows that, for about half its length, the papillæ are similar to those on the body, but that anteriorly they gradually become flatter, the plates becoming much smaller and losing their concentric arrangement, so that the whole appears as a granular area surrounding the central opening. In the dorsal half of this anterior region, moreover, they become surrounded by thick bands of brown pigment which form a dense network between them and tend to obscure their height, but in the ventral half the pigment is absent and it is easy to trace their gradual flattening (Pl. II. fig. 1 *c*).

This species is obviously very like *Ph. psaron*, but there are certainly no spines on the introvert and the papillæ differ in certain features. Thus Sluiter says "Sonst kommen im Rüssel nur dunkle Leisten vor, aber keine gesonderte Papillen," which hardly agrees with the arrangement found here. Otherwise the general anatomy is closely similar, save only that the nephridia are half and not three-quarters the length of the body, and attached for two-thirds and not one-third of their own length. Sluiter's description is rather brief and he has not figured his species, but I feel reasonably certain that the two forms are distinct.

7. Physcosoma gaudens, sp. nov. (Plate II. fig. 2.)

Loc. Pulau Bidan, Penang.

Three specimens.

This form would appear to be the Eastern representative of the Western *Ph. weldonii*, Shipley. In all general features it closely resembles the latter, but in regard to the papillæ of the body it is distinctly different; these consist, in Shipley's species, of a number of brown horny plates with pigment in between, while in the present species they consist of two rings of small transparent plates round the central opening, then a ring of about six large brown plates, and then another more or less complete ring of slightly smaller irregular brown plates, pigment granules being absent (fig. 2). The actual resemblances between the two forms are the relative shortness of the introvert and absence of hooks, the brown papillæ especially crowded on the introvert, the presence of only two retractors, and the diverticula on the contractile vessel. The differences, except as regards the body-papillæ, are slight and obviously only differences of degree, and I give them in tabular form :—

Ph. weldonii.	*Ph. gaudens.*
Longitudinal muscles 10–12, splitting into two in the middle of the body, and fusing at hind end.	Muscles 14, splitting in the middle of the body, but into more than two, so that posteriorly there are as many as 34; not fusing at hind end.
Opening of nephridia a little behind anus.	Opening of nephridia at anus level.
Retractors arise at a level between the anterior two-thirds and the posterior one-third of the body.	Retractors arise at the level of the middle of the body.

III. Genus Phascolosoma.

8. Phascolosoma pyriformis, sp. nov. (Plate II. fig. 3.)

Loc. Pulau Bidan, Penang.

Numerous specimens.

The expanded animal is pyriform in shape, the introvert being considerably shorter than the body. The skin is thick, without papillæ when seen under the lens; in most of these specimens the colour is a dirty-white with a slight tinge of very pale green which may be due to the reagent. Some, however, are distinctly reddish-brown (*i. e.*, a lightish copper), and in nearly all it is noticeable that the skin is covered with splashes of white, which just behind the tentacles are aggregated into a broad white ring.

Internally the most peculiar character is that both anus and nephridia open on the introvert, the anus halfway between its base and the tentacles, the nephridia just in front of its base (*v.* fig. 3 *a*). The muscle-layers are continuous, and there are two broad and short retractors which arise within the middle third of the body and fuse directly they meet. The œsophagus, covered by a contractile vessel with numerous black-tipped diverticula, extends to the extreme hind end of the body (at which point the contractile vessel ceases), and then bends sharply forward dorsal to the intestine to enter the latter at the anterior end of the body; in its anterior half this part of the œsophagus is held in place by three small muscles which converge to be inserted fairly close together in the mid-dorsal line. The intestine is much coiled and opens at the anus by means of a rather short rectum; it is not held down to the hind end of the body, but is attached in front by means of the spindle muscle. The nephridia are about a quarter of the body-length, hardly pigmented, their anterior portion swollen.

The papillate bodies consist of (*a*) a low circular papilla, with a wide central opening, on the external body-wall, (*b*) of the glandular portion, lying rather deep down below the cutis and epidermis, and (*c*) of a fairly long, more or less straight duct, leading to the external opening (*v.* figs. 3 *b*, 3 *c*).

IV. Genus Cloeosiphon.

9. Cloeosiphon aspergillum Quatrefages.
Selenka, *tom. cit.* p. 126.

Loc. Pulau Bidan, Penang.

One specimen.

V. Genus Aspidosiphon.

10. Aspidosiphon steenstrupii Diesing.
Selenka, *tom. cit.* p. 116.

Loc. Pulau Bidan, Penang.

One specimen.

11. Aspidosiphon elegans Cham. & Eysenh.
Selenka, *tom. cit.* p. 124.

Loc. Pulau Bidan, Penang.
Fifteen small specimens.

12. Aspidosiphon insularis, sp. nov. (Plate II. fig. 4.)

Loc. Pulau Bidan, Penang,
Two damaged specimens.

The longitudinal muscles are split into bundles which anastomose rather freely; they appear stronger behind the level of the retractors, where they number about 22, but in front of this level the transverse bands appear more prominent and the longitudinal muscles number only 15. The retractor muscles are four in number, and take their origin a little behind the middle of the body, the ventrals arising from longitudinal muscles 2–6, the dorsals from 5–6 only, a very little distance in front of the ventrals; the pairs unite very quickly, but the united pairs do not join till moderately close to the tentacles. The nephridia are long, extending from their opening, at the same level as the anus, close to the base of the introvert, to some little distance behind the retractors; they are brown in colour, and attached only in their front portion, which is slightly swollen. A well-marked spindle-muscle holds the intestine down to the hind end of the body, which, in the specimen figured, is invaginated for a little distance.

Externally the body is a dirty-white and dotted with small brown papillæ, which in the middle of the body are only visible under the lens, but which increase in size towards the hind end. The anal shield is circular, and formed of crowded, large, brown papillæ. The introvert is less than half the length of the body; in front it carries a few rows of hooks (fig. 4 *b*), and behind rather large papillæ, each of which terminates in a dense, almost tooth-like structure (fig. 4 *c*). Along the dorsal line the papillæ are enclosed by a dense brown pigment.

Echiurida.

VI. Genus Thalassema.

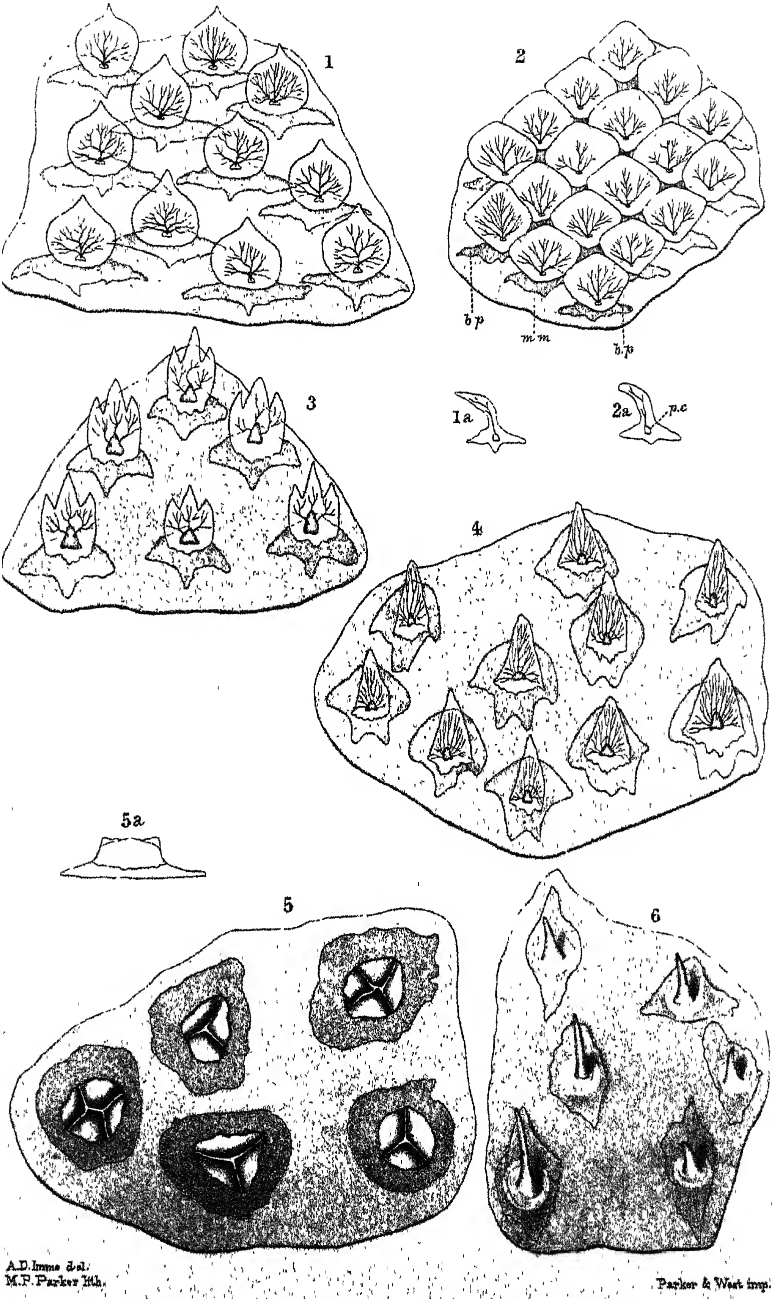
13. Thalassema sabinum, sp. nov. (Plate II. fig. 5.)

Loc. Tale Sab, Singora. "In channel at top of brackish part." Five specimens.

The characteristic features of this species are as follows:—

a. The proboscis is short as compared with the body;
b. There are two pairs of nephridia with spiral openings;
c. The muscle-sheath is continuous;
d. The anal trees are short;

which conjunction of characters at once separates it from the other members of the genus. The animal is small, measuring in



A.D. Imms del.
M.P. Parker lith.

Parker & West imp.

PHARYNGEAL DENTICLES OF ELASMOBRANCHS.

one instance 10 mm., of which the proboscis forms only the fifth part, *i. e.* 2 mm. The ventral hooks lie close up behind the proboscis. The skin is rather thin, and only partially transparent so far as concerns most of the internal organs, but the nerve-cord is clearly visible from the outside. The structure of the papillate bodies is shown in fig. 5.

EXPLANATION OF PLATE II.

Fig. 1. *Physcosoma socium* (p. 37). *a.* Dissection showing internal anatomy. *b.* Papilla from mid-body. *c.* Skin of introvert, showing gradual flattening of the papillæ.
Fig. 2. *Physcosoma gaudens* (p 38). Papilla from the hind end of the body.
Fig. 3. *Phascolosoma pyriformis* (p. 39). *a.* Dissection showing internal anatomy. *b.* Papilla from the front end of the body, surface view. *c.* The same in section.
Fig. 4. *Aspidosiphon insularis* (p. 40). *a.* Dissection showing internal anatomy. *b.* Hooks. *c.* Papilla from the base of the introvert.
Fig. 5. *Thalassema sabinum* (p. 40). Skin from the front of the body.

7. On the Oral and Pharyngeal Denticles of Elasmobranch Fishes*. By A. D. Imms, B.Sc. (Lond.), Zoological Laboratory, University of Birmingham.

[Received November 1, 1904.]

(Plate III.†)

It is well known that in the Elasmobranch Fishes true teeth are carried only in relation with the palato-quadrate and mandibular cartilages. Minute denticles, however, may be present in greater or less abundance in many parts of the lining of both the oral and pharyngeal cavities. Very little has been written with regard to these structures, and, although reference is made to them by Hertwig, Popta, and others, the only general description of them is that recently published by Steinhard‡.

I have been led to devote some attention to them as the outcome of an account which I have recently given of the structure of the gill-rakers of the Ganoid Fish *Polyodon spathula* §. In that paper I suggested that the gill-rakers of *Polyodon* may perhaps be regarded as scales (or denticles) which have migrated from the exterior of the body on to the branchial arches, and have there become greatly modified into long setiform structures. In order further to test the possibility of this suggestion, I have examined examples of species belonging to a considerable number of genera of Elasmobranchs for the purpose of ascertaining whether denticles of any description are present on the branchial arches in those Fishes. Given the presence of denticles on the branchial arches in such forms, it would not be difficult to conceive that the type of

* Communicated by Prof. T. W. Bridge, F.R.S., F.Z.S.
† For explanation of the Plate, see p. 49.
‡ Archiv für Naturgesch. lxix. Bd. i. 1903, pp. 1–46, Taf. i. & ii.
§ Proc. Zool. Soc. 1904, vol. ii. pp. 22–35, pl. ii.

gill-raker met with in *Polyodon* and *Cetorhinus* might have been derived from them through their spinous portions becoming greatly elongated. As the result of this examination, I have found that denticles are of very frequent occurrence both on the branchial arches and on the mucous membrane lining the mouth and pharynx in these Fishes. A brief account of the observations which I have made on these structures is embodied in the present article. I am indebted to Prof. T. W. Bridge, F.R.S., for helpful criticism and for his kindness in placing at my disposal a number of examples of various fishes. To Mr. G. A. Boulenger, F.R.S., I also owe a debt of gratitude for allowing me to examine specimens of several genera of Elasmobranchs in the Collection of the British Museum. My investigation of this subject was commenced about the time when Steinhard's paper was published, and I did not become aware of the latter until my work was nearing completion. When I came to read his paper, I found that I had conducted my studies on similar lines and, moreover, that about half the species examined by me had already been investigated by him. As the result of this coincidence, I found it necessary to curtail the present paper considerably below its original dimensions, and, in its emended form, I offer it as a small additional contribution to a knowledge of these denticles.

In his paper Steinhard refers to the oral and pharyngeal denticles as "Schleimhautschuppen," or "mucous membrane scales," and he describes their form, arrangement, and distribution in a number of cases. The first part of his description treats of their occurrence among the Selachoidei, and the following species of the latter were examined by him:—*Heptanchus cinereus*, *Mustelus vulgaris*, *Carcharias glaucus*, *Pristiurus melanostomus*, *P.* sp., *Acanthias vulgaris*, *Centrophorus* sp., *Scyllium burgeri*, *S. canicula*, *Galeorhinus japonicus ?*, *Spinax niger*, and *Squatina vulgaris*. He points out that from among these twelve species nine out of them possessed "Schleimhautschuppen." In some forms (*Heptanchus*, *Mustelus*, *Carcharias*) the whole of the mucous membrane lining the mouth and pharynx down to the commencement of the œsophagus is closely covered with them. In others (*Acanthias*, *Pristiurus* sp.) they invest the mucous membrane of the branchial arches, but their distribution over the rest of the mouth and pharynx is more restricted. In *Pristiurus melanostomus*, *Centrophorus* sp., and *Scyllium burgeri* denticles were only present over the mucous membrane covering the branchial arches, while in *Squatina* they are confined to the lining of the oral cavity. The second part of the paper deals with *Galeorhinus canis* and the Batoidei. In the former, he describes the whole of the oral and pharyngeal cavities, together with the branchial arches, as being completely covered with denticles which extend as far back as the commencement of the œsophagus. A similar condition was met with in *Pristis perotetti*, which he considers in this respect to be the most primitive of the Batoidei. The other members of the group which he examined were *Rhynchobatis*

djeddensis, *Raja clavata*, *Torpedo marmorata*, and *Trygon sephen*, together with *Chimæra monstrosa*. The paper is accompanied by numerous figures which show the varied forms assumed by these denticles. Those of *Heptanchus* in nowise differ in their form from the placoid scales of the skin in that genus. Those of *Mustelus* and *Pristis* are regarded as being intermediate in form between the teeth of the respective species on the one hand and the placoid scales on the other. In other genera their resemblance to the placoid scales becomes more remote. The author briefly refers to the function of these structures, and suggests that they may serve in grinding up the food. For that purpose a slight side rubbing-movement of the jaws and gill-apparatus might suffice. By means of such a motion the scaly mucous membrane would act like two rough surfaces. Mention is also made of the difficulty to account for the presence of such structures over an area like the pharynx, which is of hypoblastic origin. He shares the view of Hertwig that their presence in that region is more likely due to a migration of the ectoderm rather than to the possibility of the hypoblast having acquired a scale-forming capacity.

My observations on the presence and distribution of oral and pharyngeal denticles have been made on specimens belonging to eighteen genera of Elasmobranchs.

A. SELACHOIDEI*.

Fam. CARCHARIIDÆ.

1. CARCHARIAS GLAUCUS Rond.—In an individual which measured 39 cm. in length, denticles were present over the floor of the oral cavity and along the pharyngeal margins of the branchial arches. Steinhard remarks that in an example of this species which he studied, measuring 46 cm. long, the whole of the cavity of the mouth and pharynx, together with the branchial arches, were covered with denticles which extended as far back as the commencement of the œsophagus.

2. C. LATICAUDUS Müll. & Henle.—An examination of four specimens of this species, varying in length from 18–42 cm., showed that the oral cavity was closely covered with minute denticles, which extended backwards to about the level of the first gill-clift. In the region of the pharynx they were found only along the inner or concave margins of the branchial arches. In a fifth example of this fish, 26 cm. long, no denticles were to be detected except a few along the branchial arches.

3. SPHYRNA (ZYGÆNA) MALLEUS Risso.—In this species the whole of the lining of the oral and pharyngeal cavities, as far back as the entrance into the œsophagus, was covered with a complete

* In this classification I have followed Günther, Brit. Mus. Cat. Fishes, vol. viii. 1870.

pavement of denticles very closely packed together. A similar investment covered the branchial arches up to the bases of the gill-filaments. The specimen examined measured 56 cm. in length.

4. Mustelus lævis Rond.—In an example measuring 150 cm. long the distribution of denticles over the mouth and pharynx was similar to that in *Sphyrna*. It will be seen on referring to Pl. III. fig. 1, that the denticles of this species are rhomboidal in shape with rounded angles, and each has a well-defined basal plate. They are very closely packed together, so that each partially overlaps two or more of its fellows immediately behind. Their basal plates are also seen to closely interdigitate with one another.

5. Galeus (Galeorhinus) canis Rond.—Denticles in this species have a distribution identical with that found in *Sphyrna* and *Mustelus*. In Pl. III. fig. 2 is represented a strip of the mucous membrane of the pharynx with the denticles *in situ*. It will be observed that they are closely and regularly arranged together, but no imbrication takes place as in *Mustelus*. The fish examined measured 155 cm. in length.

Fam. Lamnidæ.

6. Lamna (Oxyrhina) cornubica Gmelin.—In a specimen measuring 79 cm. in length the denticles had a distribution identical with that found in the three preceding genera.

Fam. Notidanidæ.

7. Notidanus (Heptanchus) cinereus Gmelin.—In an example of this species measuring 65 cm. in length denticles were found to be generally distributed over the lining of the mouth and pharynx, and also to extend over the pharyngeal edges of the branchial arches. They were absent, however, from the anterior and posterior faces of the latter. In form they are characteristically tricuspid, as is represented in Pl. III. fig. 3, and are identical in all respects with the placoid scales of the skin.

Fam. Scylliidæ.

8. Scyllium canicula L.—After an examination of a number of examples of this fish, which were used for class demonstrations, no denticles were to be detected over any part of the lining of the mouth or pharynx.

9. Chiloscyllium indicum Gmelin.—In a specimen 34 cm. long denticles were found scattered somewhat irregularly over the lining of the mouth and pharynx, but they did not extend on to the branchial arches.

10. Pristiurus melanostomus (Rafinesque) Blainv.—In a very young individual, 14 cm. in length, oral and pharyngeal denticles

were entirely absent. In two much larger specimens (47 cm. and 58 cm. long respectively), studied by Steinhard, denticles were found to be present on the mucous membrane investing the gill-arches.

Fam. HETERODONTIDÆ.

11. HETERODONTUS (CESTRACION) PHILIPPI (Bl.).—In a museum specimen, measuring 60 cm. in length, coarse denticles were present on the roof and floor of the mouth and pharynx, but as the specimen was not available for dissecting purposes I was unable to determine the precise limits of their distribution.

Fam. SPINACIDÆ.

12. CENTRINA SALVIANI Risso.—In an example 23 cm. long oral and pharyngeal denticles were found to be entirely wanting.

13. ACANTHIAS VULGARIS Risso.—An examination of several specimens of this fish, whose length averaged about 60 cm., showed that denticles were present over the floor of the mouth and pharynx, and extended from the latter on to the mucous membrane covering the branchial arches, where they extended as far as the bases of the gill-filaments and even over the gill-rakers also. In a young fish, 26 cm. long, the denticles had not yet appeared above the surface of the mucous membrane, with the exception of a small patch over the region of the basi-branchial cartilage. A portion of the mucous membrane, from the floor of the pharynx of this species, containing denticles, is represented in Pl. III. fig. 4.

Fam. RHINIDÆ.

14. RHINA SQUATINA L.—In an example of this species measuring 80 cm. long denticles were found sparsely scattered in an irregular manner over the roof and floor of the oral cavity, and they extended also on to the pharyngeal margins of the hyoidean and first branchial arches. The denticles of this species are very remarkable in their form (*vide* Pl. III. fig. 5). Each consists of a large basal plate, irregular in its outline, and in its centre is a boss-like protuberance which has its surface intersected by several blade-like ridges. The protuberance appears to be the last remnant of the spinous portion of the denticle which attains its full development in the placoid scales of the skin.

Steinhard deals with this species in considerable detail, and he regards the denticles as being placoid scales which have not reached their full development owing to an insufficient supply of lime salts.

B. BATOIDEI.

Fam. RHINOBATIDÆ.

15. RHINOBATUS PRODUCTUS Girard.—In this species, closely arranged denticles completely invest the lining of the mouth and

pharynx and extend backwards to the junction of the latter with the œsophagus. No denticles, however, extend on to the branchial arches, and the junction of the mucous membrane covering the latter with that of the pharynx is clearly defined, as the denticle-covered area ceases very abruptly. As the specimen examined measured only 27 cm. in length, this condition is probably owing to the denticles not having yet attained their full development.

Fam. TORPEDINIDÆ.

16. TORPEDO OCELLATA Rudolphi.—In two examples of this species, each of which measured a little over 30 cm. long, no denticles were to be detected over any part of the lining of the mouth or pharynx.

Fam. RAJIDÆ.

17. RAJA CLAVATA L.—In a young specimen, 30 cm. long, very minute denticles were found irregularly distributed over the mucous membrane of the branchial arches and the adjacent portions of the roof and floor of the pharynx. The denticles are spine-like in form and have relatively large basal plates. *Vide* Pl. III. fig. 6.

Fam. TRYGONIDÆ.

18. TRYGON WALGA Müll. & Henle.—Oral and pharyngeal denticles were totally absent in an example of this species measuring 47 cm. long.

Fam. MYLIOBATIDÆ.

19. MYLIOBATIS AQUILA L.—In a specimen 40 cm. long oral and pharyngeal denticles were likewise totally absent.

C. HOLOCEPHALA.

20. CHIMÆRA MONSTROSA L.—In two examples of this fish, one of which measured about 60 cm. to the tip of the tail, no traces of denticles were to be detected in any part of the mouth or pharynx.

To this list may be added two species, examples of neither of which have been examined by Steinhard nor by myself, viz.:—*Alopias vulpes* (Fam. Lamnidæ) and *Echinorhinus spinosus* (Fam. Spinacidæ). Dr. Popta* in a recent paper entitled "Les Appendices des Arcs Branchiaux des Poissons," which deals with the gill-rakers and pharyngeal armature of Teleostomes, has some remarks on these two Elasmobranchs. With regard to *Alopecias* he says:—"Les arcs n'ont pas d'appendices et, il n'y a pas des dents pharyngiales, mais les bordes larges et la partie supérieure de la

* Ann. Sci. Nat., Zool. t. xii. 1900, pp. 139–216.

largeur des arcs, la place des dents pharyngiales inférieures et partiellement la place des dents pharyngiales supérieures sont couvertes de très petites écailles rudes et pointues, la pointe dirigée en arrière." On *Echinorhinus* he remarks, "Appendices* deux côtés 1er, 2e, 3e, 4e et côté extérieur 5e arc, longs sans dents, long 6 mm." . . . . . "Pas de dents pharyngiales inférieures à voir. Pas de dents pharyngiales supérieures à voir."

In his account of the primitive Shark *Chlamydoselachus anguineus*, Garman † mentions that both the mouth and throat of that fish are covered with scales which are largest on the inner edges of the gills.

It will be noted from the foregoing account that the presence of denticles in the lining of the mouth and pharynx is of very wide distribution among the Elasmobranchii. Out of the nineteen species which I have examined, only five were found to be totally devoid of them. If there be added to these the species examined by Steinhard and Popta we have a total, with *Chlamydoselachus*, of thirty-two species, out of which only nine (or about 28 %) have no denticles whatever.

The facts and conclusions that are to be gleaned from a study of these denticles may be summarised as follows :—

1. In *Heptanchus cinereus*, *Chlamydoselachus anguineus*, *Mustelus lævis*, *Galeus canis*, *Sphyrna malleus*, *Lamna cornubica*, and (probably) *Rhinobatus productus*, denticles are uniformly distributed over the whole of the mucous membrane of the mouth, pharynx, and branchial arches, and extend backwards to the commencement of the œsophagus. Since this condition is met with in such generalised types as the two first named genera, there is good reason to believe that it represents the primitive method of distribution which has been inherited by them from the ancestral forms of existing Elasmobranchs. It seems probable that the variations in the distribution of the denticles which are met with in other species have been derived from this condition through their becoming restricted to certain areas only. The first and simplest modification is exhibited in *Acanthias vulgaris*. In this species the denticles are wanting from the roof of the mouth and pharynx. In *Alopecias vulpes* these structures are absent from both the roof and floor of the mouth and pharynx, and hence they are restricted to the pharyngeal margins of the branchial arches. In *Rhina squatina* they have ceased to be developed in the pharynx except on the mucous membrane covering the hyoid and first branchial arches. They are retained, however, over a considerable area on both the roof and floor of the oral cavity. In *Scyllium canicula*, *Echinorhinus spinosus*, *Myliobatis aquila*, *Torpedo ocellata*, and *Trygon walga* denticles have become lost altogether.

2. In all cases where I have examined the denticles microscopically, their structure and form proved that they were un-

* *I. e.* gill-rakers.

† Bull. Mus. Comp. Zool. Harvard Coll. vol. xii. No. 1, 1885, p. 2, pl. v.

doubtedly placoid scales. I have omitted to give an account of their characters in the various species since they are described in detail for many forms by Steinhard, and I need only add that my own observations are in entire accordance with his results.

3. The facts which I have been able to make out lend but little support to the possibility of these structures performing any definite function. There appears to be no relation between the extent of the development and distribution of the denticles and the nature of the food of the various species in which they are found. For instance, in both *Galeus canis* and *Mustelus lævis* the denticles are distributed over an exactly similar area, and there is but a small difference in the form of the individual denticles in the two cases. Nevertheless, *Galeus* preys on other fish, and has its teeth modified for that purpose, while in *Mustelus* the teeth are pavement-like, and are used for crushing the shell-fish &c. on which it feeds.

The spinous portions of the denticles were found in all cases to be directed towards the caudal extremity of the fish, and this renders it possible that the denticles may perhaps serve to roughen the mouth and, by this means, assist in the swallowing of the food. There is also the suggestion make by Steinhard, that they may serve to some extent in grinding up the food, but it is difficult to conceive that they could be of much utility in this direction, for in not a a few cases the denticles are so small as to only produce a barely perceptible roughness to the touch.

It is possible that the denticles may subserve one or both of these functions, although their value in these respects must be very slight. A more probable view, and one more in accordance with their variable distribution and the absence of any obvious correlation between the nature of the food and the presence, absence, or degree of development of the denticles, is that these structures are vestigial organs. It is well known how tenaciously vestigial structures persist, even when they do not subserve any conceivable function, so long as their retention is harmless to the organism. In the case of the denticles, their persistence would not involve any serious tax on nutrition during their development, nor be detrimental in any other way, and under such circumstances, once they had been evolved for any special purpose, the tendency of heredity might be sufficient to secure their retention, even though their primitive physiological value had become lost. The fact that the denticles are relatively late in developing argues strongly in favour of their being vestigial organs. Thus in an *Acanthias vulgaris* 26 cm. long, although the teeth and dermal denticles were present, oral and pharyngeal denticles had only commenced to develop over a very limited area. In a *Carcharias glaucus* 39 cm. long these denticles had not yet attained their full development; and in a *Pristiurus melanostomus* 14 cm. long no indications of them were to be detected.

Unfortunately we know nothing concerning the habits of the

ancestral Vertebrates or for what particular mode of feeding the structure of their mouth was adapted. It is highly probable that some light might be thrown on the primitive use of the oral denticles, if one knew the precise nature and disposition of the skeletal structures which bounded the oral cavity in the primitive Vertebrates before the anterior branchial arches ceased to be purely gill-bearing and had acquired the special characters of jaws, as seen in the most primitive of existing Gnathostomata. In the primitive Vertebrata it is possible that the seizure, holding, or perhaps even the crushing of the food may have been effected by the movements of the ventral portions of the arches towards the roof of the oral cavity, after the fashion of the hypopharyngeal teeth in connection with the hinder branchial arches in many Teleosts. If there be any truth in this suggestion, it will not be difficult to appreciate the physiological value of an extensive distribution of denticles over the greater part of the oral and pharyngeal mucous membrane in the primitive Vertebrates. With the evolution of special jaws at a later period, the functional denticles would naturally tend to become restricted to them and constitute ordinary teeth, leaving, however, the residue of the stomodeal invasion of dermal denticles to become pharyngeal teeth, or gill-rakers, or to remain as vestigial structures, or to vanish altogether.

EXPLANATION OF PLATE III.

The figures are all magnified about 80 times and are from preparations examined in glycerine, which, in the case of figs. 1–4, rendered them sufficiently transparent for the internal structure of the denticles to be seen.

The spinous portions of the denticles are directed towards the caudal extremity of the fish.

Reference Letters.

b.p.=basal plate; *d.t.*=dentine tubuli; *m.m.*=mucous membrane; *p.c.*=pulp-cavity.

Fig. 1. A piece of the lining from the floor of the oral cavity of *Mustelus lævis* (p. 44), showing the very closely arranged denticles.

Fig. 1 *a*. A single denticle from the same, viewed laterally.

Fig. 2. A strip of the mucous membrane from the floor of the pharynx of *Galeus canis* (p. 44). The denticles are seen to have a regular and orderly arrangement, but are not so closely disposed together as in *Mustelus*.

Fig. 2 *a*. A single denticle of *Galeus*, viewed laterally.

Fig. 3. A portion of the mucous membrane lining the floor of the pharynx of *Notidanus cinereus* (p. 44).

Fig. 4. A portion of the mucous membrane from the pharynx of *Acanthias vulgaris* (p. 45), taken from where the last two branchial arches join the floor of the same.

Fig. 5. A piece of the lining of the roof of the oral cavity of *Rhina squatina* (p. 45).

Fig. 5 *a*. A single denticle from the same, viewed laterally.

Fig. 6. A strip of the mucous membrane lining the roof of the pharynx of *Raia clavata* (p. 46), taken from near the last two branchial arches. In this species and in *Rhina* the denticles have lost their regular arrangement and are scattered over the mucous membrane as if at random.

8. Note on some recently discovered Remains of the Musk-Ox (*Ovibos moschatus* Zimmermann, sp.) from the Pleistocene Beds of Southern England. By C. W. Andrews, D.Sc., F.Z.S. (British Museum, Natural History).

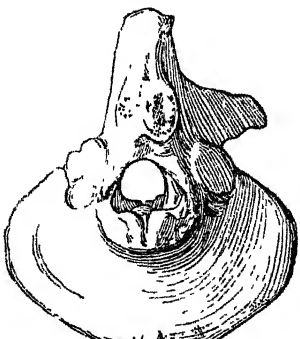
[Received January 9, 1905.]

(Text figures 13 & 14.)

Since 1855, the date of the discovery by Lord Avebury and the Rev. Charles Kingsley of a skull of the Musk-Ox in the low-level gravels of the Thames at Maidenhead, only some half-a-dozen instances of the occurrence of remains of this animal in Britain have been recorded. Details of these finds are given by Prof. Boyd Dawkins in the Memoir on the Pleistocene Mammals of Britain, Pt. V., published by the Palæontographical Society*. Remains of this animal being so rare, no apology will be needed for drawing attention to two recent discoveries of further evidence of its former existence in this country. The first of these was made in 1902 by the Rev. B. Hale Wortham, who found in the Brick Earths of the Thames at Plumstead an axis vertebra, part of a right femur, and the shaft of a radius, which were presented to the British Museum, where they were determined by Dr. A. Smith Woodward as belonging to this species.

The axis (text-fig. 13) has been compared with that of a large

Text-fig. 13.



Axis vertebra of Musk Ox, from Brick-earths of the Thames at Plumstead.

male Musk-Ox from North America, and has been found to differ from it in size and in some details of structure. It is considerably

* Mon. Palæont. Soc. 1872.

larger and more massively constructed, the neural spine especially being much thicker. The posterior part of the pedicle of the arch is perforated by a channel which opens anteriorly into the groove for the second spinal nerve, and posteriorly on the hinder face of the base of the transverse process. This latter opening is present in the recent vertebra, but the passage from it seems to lead into the substance of the bone of the centrum. The posterior zygapophyses are considerably more massive in the fossil. The dimensions of the recent and fossil axes are as follows:—

	Fossil.	*Recent.*
	cm.	cm.
Width of anterior face of centrum	11·8	11·0
Height " " "	5·4	4·9
Length from tip of odontoid to middle of posterior face of centrum	7·5	6·4
Width of posterior face of centrum	7·0	6·2
Height " " "	5·8	4·9
Length of ventral surface of centrum ...	6·2	5·4

A portion of a left ulna from Plumstead consists of the shaft only. As in the case of the axis, this bone is larger and stouter than that of the recent animal, with which it was compared as far as its incomplete condition allowed. It was probably three or four centimetres longer: the least width and circumference of the shaft are 4·5 cm. and 12·3 cm. respectively, as compared with 4 cm. and 10·8 cm. in the recent bone. Professor Boyd Dawkins gives the circumference of a radius measured by him as 4·4 in. (approximately 11 cm.).

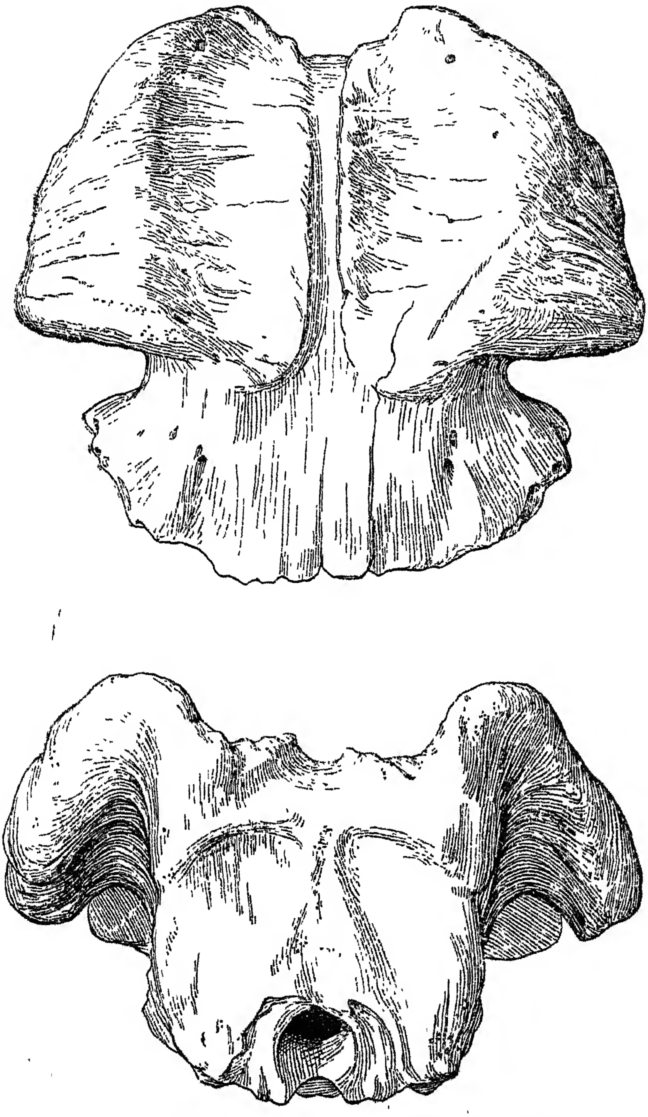
An imperfect femur, also wanting the extremities, was found in the same place. It seems to have been longer and at the same time more slender than in the recent animal. Its length from the tip of the lesser trochanter to the middle of the supra-condylar fossa is 18 cm.: the width and circumference of the shaft are 5·1 and 11 cm. respectively. In the recent animal these measurements taken at corresponding points are :—length 17·3, width 3·4, circumference 11·7 cm.

The most recent find of Musk-Ox remains consists of an incomplete skull of an old bull (text-fig. 14, p. 52): this specimen, which is much rolled and water-worn, was discovered by Mr. Wm. T. Rennie near the base of a bed of gravel about eleven feet thick, near Frampton-on-Severn, about five miles from Stonehouse, Gloucestershire. Both this specimen and a humerus of *Bos primigenius* from a few feet above it have been presented to the British Museum by the finder.

The skull has lost the whole of the facial region in front of the orbits above and the cribriform plate below. Moreover, nearly all the prominent points are greatly abraded: thus the ends of the horns, the occipital condyles, and the mastoid region together with the paroccipital processes are wanting. The obliteration

of most of the sutures and the large size of the horns indicate that the animal was an old male. The basioccipital shows the

Text-fig. 14.



Two views of skull of Musk-Ox, from near base of bed of gravel at Frampton-on-Severn, Gloucestershire.

characteristic quadrate form: both the anterior and posterior muscular prominences are almost completely worn away, and just the base of the fused pterygoid plate remains as a rounded ridge. The tympanic is wanting, a circumstance which, together with the abrasion of the paroccipital and other prominences, gives the skull a very peculiar appearance, differing much from the recent type: but comparison of the foramina and other features not affected shows that in fact scarcely any difference exists.

The occipital surface is quadrate owing to the removal of the ventro-lateral region. The base of the horn-cores and the roof of the skull between them are much less raised above the lambdoidal crest than in the recent skull, and the same is the case with the specimen from Maidenhead. On the other hand, the skull from Crayford described by Professor Boyd Dawkins is more like the recent form, so that perhaps this peculiarity is merely due to difference of age or to individual variation. The cranial portion of the horn-core is more concave from side to side and longer from before backwards than in the specimen from Maidenhead.

The dimensions of the skull here referred to are given (in centimetres) in column A; those of the Crayford specimen (where possible) in B, of the Maidenhead skull in C, and of that of a recent adult bull in D.

	A.	B.	C.	D.
Greatest width of occipital surface	13·2	.	20 app.	17·5
Height from foramen magnum to top of lambdoidal crest	8·2	...	9·0	9·2
Height from foramen magnum to roof of skull	10·2	14·7	11·5	13·3
Least width of skull behind orbits	15·5	..	15 app.	12·5
Length of base of horn-cores	18·8	22·8	17·4	20 app.
Distance between bases of horn-cores	1·0	1·5	1·5	1·3
Width of foramen magnum	3·0	3·8	...	3·0
Height of foramen magnum	2·7	...	...	2·8

Although careful examination of the specimens above referred to supplies no reason for supposing that the Musk-Ox of Pleistocene Britain differed specifically from the existing animal, it may be suggested that it was somewhat more heavily built, and perhaps, on the average, rather larger. These differences are probably the natural result of living in a less rigorous climate and with more abundant food than the recent form, conditions that may be fairly inferred from the fact that the fossil remains are from deposits which contain an abundant mammalian fauna, including such large herbivores as *Bos primigenius* and *Bison priscus*.

9. Descriptions of Three new Species of Birds obtained during the recent Expedition to Lhassa. By HENRY E. DRESSER, M.B.O.U., F.Z.S.

[Received January 17, 1905.]

(Plates IV. & V.*)

Col. Waddell, C.B., who has recently returned from India, having been one of the officers on the Tibet expedition, when there made a collection of birds, most of which, he tells me, he was able to identify by my 'Manual of Palæarctic Birds.' Some, however, he failed to recognize, and these he kept by him, and has sent them on to me for identification, requesting me to describe any that are new. The rest, however, were with his baggage, and were unfortunately lost on the return march from Lhassa.

Amongst the birds which were fortunately saved I find the following to be undescribed, viz.:—

BABAX WADDELLI, sp. n. (Plate IV.)

Adult male (Tsangpo Valley, Tibet, 25th Sept., 1904).—Upper parts dull ashy grey, each feather with a broad central blackish stripe, the rump slightly less striped than the rest of the upper parts; wing blackish brown, most of the feathers externally margined with ashy grey; tail blackish brown, much graduated; under parts similar to the upper parts, but somewhat paler and more narrowly striped; bill and legs plumbeous, iris dull orange. Total length about 12·60 inches, culmen 1·40, wing 5·10, tail 6·50, tarsus 1·70.

The nearest ally to this species appears to be *Babax lanceolatus*, from which, however, it differs considerably, being larger (wing 5·10 against 3·75, tail 6·50 against 5·0), and, as will be seen by the above description, it differs considerably both in colour and markings. It is, Col. Waddell says, "called by the Tibetans '*Tĕh-Tĕh*,' in imitation of its call. It frequents poplar and alder thickets remote from villages. It was gregarious, going about in parties of 8 to 10 individuals, but was not so active and secretive in its movements as the *Garrulax*, alongside of which it was met with."

GARRULAX TIBETANUS, sp. n. (Plate V. fig. 2.)

Adult male (Tsangpo Valley, Tibet, 25th Sept., 1904).—Upper parts dark brown with a tinge of olivaceous, the crown slightly darker; lores and a patch through the eye with the ear-coverts blackish chocolate; quills blackish, externally margined with slate or dark lavender-grey; wing-coverts like the back; tail graduated, blackish brown broadly tipped with white; under parts rather paler than the upper parts; a broad white stripe below the eye, and a few white feathers above the eye indicating a stripe; under

* For explanation of the Plates, see p. 55.

♂

BABAX WADDELLI.

H.Gronvold del.et lith. Mintern Bros. imp.

1. LANIUS LAMA. 2. GARRULAX TIBETANUS.

tail-coverts and lower flanks chestnut-red. Bill and legs dark plumbeous, iris dull crimson. Total length about 10·50 inches, culmen 0·90, wing 4·50, tail 6·40, tarsus 1·50.

From its nearest ally *Garrulax sannio*, this species differs in having the upper parts much darker and more uniform in colour, the crown not chestnut-brown, the under parts darker, without any white or ochraceous on the belly, and in the tail having a broad white terminal band. Col. Waddell informs me that "it is called by the Tibetans '*Jomo*,' or the Lady; it is found in the same poplar and alder thickets as the *Babax*, but also comes up quite close to the villages. It has the characteristic habits of a Babbler in a marked degree, roves about in parties of eight or more individuals, chatters more noisily, uttering its fluty call of *Whoh-hee, Whoh-hee*, is always on the move scampering along the branches, is very secretive, seldom showing itself, and flying very low across a clearance to the next cover."

Lanius lama, sp. n. (Plate V. fig. 1.)

Adult male (Tsangpo Valley, Tibet, Sept. 1904).—Head, nape, and upper parts generally dark plumbeous, much as in *Lanius algeriensis*; a narrow line across the forehead, the lores, and a broad band through and behind the eye deep black; lower rump and upper tail-coverts rufous; wings black, the inner secondaries and larger wing-coverts narrowly margined with dull white; tail uniform blackish brown, rather pale at the extreme tip; under parts white, the breast, flanks, and under tail-coverts washed with rufous fawn. Total length about 10·10 inches, culmen 0·83, wing 4·20, tail 5·0, tarsus 1·12.

Lanius schach appears to be the nearest ally to the present species, but the latter has only a narrow black line across the forehead, the upper parts are much darker, it has no rufous on the back or scapulars, but only on the lower rump and upper tail-coverts, and has no trace of a white alar speculum.

The other birds sent are *Pica bottanensis*, *Turtur orientalis*, *Otocorys elwesi*, a young Lark which I cannot separate from *Alauda arvensis*, and *Parus cinereus*, which, however, has a slightly larger bill and longer wing than typical examples, but without a series it is impossible to say if it can be regarded even as a subspecies.

All the above-mentioned birds were obtained in the Tsangpo Valley, near the Chuksam Ferry, at an elevation of 12,100 feet above the sea-level.

EXPLANATION OF THE PLATES.

Plate IV.

Babax waddelli, p. 54.

Plate V.

Fig. 1. *Lanius lama*, p. 55.
Fig. 2. *Garrulax tibetanus*, p. 54.

February 7, 1905.

Howard Saunders, Esq., F.L.S., Vice-President in the Chair.

The Secretary exhibited, on behalf of the Hon. Walter Rothschild, F.Z.S., a pair of Gorillas, mounted by Mr. Rowland Ward. He remarked that these Gorillas appeared to be on the eve of becoming adult, and that they were probably from twelve to thirteen years old. He added that Mr. Rothschild had called his attention to the unusually large red patch on the head of the male, and to the absence of the patch in the female. This difference in the coloration of the sexes confirmed Mr. Rothschild's opinion that *Gorilla castaneiceps* of Slack was not a valid species or subspecies, but was based on individual variation.

Mr. Frederick Gillett, F.Z.S., exhibited some mounted heads of the Rocky Mountain Goat (*Haploceros montanus*), and made the following remarks:—

"I have brought here to-night, specimens of the Rocky Mountain Goat, with the object of pointing out a gland which lies at the base of each horn and acts, one might almost say, as a pad to it. Under the external skin these glands consist of a soft red tissue saturated with a milky substance, like the udder of a cow. In the specimen at our Gardens these glands are partially covered up by long hair at the present time, but in October and November they are more conspicuous. The older the animal, the more pronounced are the glands."

Mr. R. H. Burne, F.Z.S., showed specimens made for the Royal College of Surgeons Museum from the viscera of the Indian Rhinoceros (*R. unicornis*), known as "Jim," that had lately died at the Society's Gardens, and made the following remarks:—

The specimens include parts of the following organs:

Stomach *.—A section showing the line of demarcation between the cardiac and glandular regions. The epithelium of the cardiac region, as in other Perissodactyles, is similar to that of the œsophagus—a stratified epithelium with easily separable corneous superficial layer. The deeper parts of the epithelium project into the submucosa in the form of elongated papillæ. These are peculiarly long and resemble very closely those in the œsophagus of the Horse. A microscopic section taken from the glandular region of the stomach, 1 ft. in front of the limit of the lower parts of the cardiac region, shows a deep layer (6 mm.) of peptic glands. The gland-tubules were about ·04 mm. in diameter.

A section taken about 1 ft. 6 in. in front of the last, from the

* Owen, "Anatomy of the Indian Rhinoceros," Trans. Zool. Soc. vol. iv. 1862, p. 40.

pyloric dilatation (Owen, *l. c.* pl. xi. figs. 1 & 2), shows a layer of pyloric glands 2 mm. thick. The gland-tubules have about twice the diameter of those of the peptic glands, but are far shorter and more branched. They are separated into groups of various size by septa running up from the submucosa.

Duodenum.—A portion, taken about 1 ft. 6 in. from the stomach, showing the papilliform valvulæ conniventes (Owen. *l. c.* pl. xii. figs. 1 & 2). Microscopic sections show that the papilliform processes are covered with villi. The interior of each process contained a number of follicles belonging to Brunner's glands. The ducts from these open upon the surface of the process between the villi. Brunner's glands were only observed within the papilliform processes, and not in the general submucosa of the intestinal wall. With hæmatoxylin they stained a vivid blue, in marked contrast to the pinkish purple of the surrounding tissues.

Gervais, who describes the histology of the small intestine of the Rhinoceros *, makes no mention of Brunner's glands; probably his sections were taken from a point further down the intestine below the level of these glands. He, however, speaks of Crypts of Lieberkuhn lying between the papilliform processes. These were not seen in the present sections.

Ileum.—Owen, *l. c.* pl. xii. fig. 3.

Cæcum.—This organ is lined by a voluminous mucous membrane, separated from the muscular wall by an extremely loose submucosa, and thus easily thrown into transient folds. The mucous membrane consists, as usual in this part of the gut, of an even and close-set series of Crypts of Lieberkuhn. They are ·25 mm. long, only about half as long as in the cæcum of the Horse.

The Larynx.—(Owen, *l. c.* pl. x. figs. 1 & 2, pl. xv. figs. 1 & 2.) The epiglottis is intranarial. The outer walls of the ventricles and lateral pouches are covered by gland-tissue. The two folds of mucous membrane that run upwards, outwards, and backwards from the anterior attachment of the vocal cords and form the anterior lips of the ventricles (Owen, p. 48) are strongly developed; they are even more marked in the Sumatran Rhinoceros, but are absent in the Tapir and Horse. Above the anterior point of union of the vocal cords is a vertical indentation of the mucous membrane of the epiglottis. In this position in the Horse and Ass there is a definite median saccus.

The Parathyroid Body.—The external appearance and position of this body are accurately given by Owen (*l. c.* p. 48). In histological structure it conforms to Welsh's type 4 †, consisting of small cells clustered so as to form globular alveoli. In some parts the masses of cells apparently do not surround a lumen, and in these places there is more resemblance to Welsh's type 3. The

* Gervais, "Structure de l'intestine grêle chez le Rhinocéros," Journ. de Zool. t. iv. (1875) p. 465.

† Welsh, "Concerning the Parathyroid Glands," Journ. Anat. & Physiol. vol. xxxii. (1898) p. 392.

individual alveoli and cell-masses are separated from one another by a delicate packing of connective tissue.

The Kidney.—(Owen, *l. c.* p. 44, pl. xiv. fig. 3.) Except at the hylus the kidney is not lobulated. Thickenings of the capsule along certain anastomosing lines give it, however, superficially a lobulated appearance.

In the entire absence of any pyramids projecting into the pelvis there is more resemblance to the Tapir than to the Horse.

The Bladder and Urethra.—(Owen, *l. c.* p. 49, pl. xvi.) The seminal vesicles and prostate are more complex than one would be led to suppose from Owen's description and figure. When fully dissected out, the seminal vesicles can be resolved into a number of convoluted tubes, that converge towards the neck of the bladder and unite to form a pair of common ducts which open into the vasa deferentia shortly before their entry into the urethra. This condition is similar to that described by Forbes* in the Sumatran Rhinoceros, but is very different to the arrangement seen in the Sondaic Rhinoceros by Beddard and Treves †, where the seminal vesicles and prostate are quite simple and compact, more nearly resembling the same organs in the Tapir.

The prostate is larger and more branched than represented by Owen.

There was a well-marked uterus masculinus, not noted by Owen.

The following papers were read :—

1. On Abnormal Ranid Larvæ from North-Eastern India. By Nelson Annandale, B.A., Deputy Superintendent of the Indian Museum, Calcutta ‡.

[Received December 13, 1904.]

(Plate VI. §)

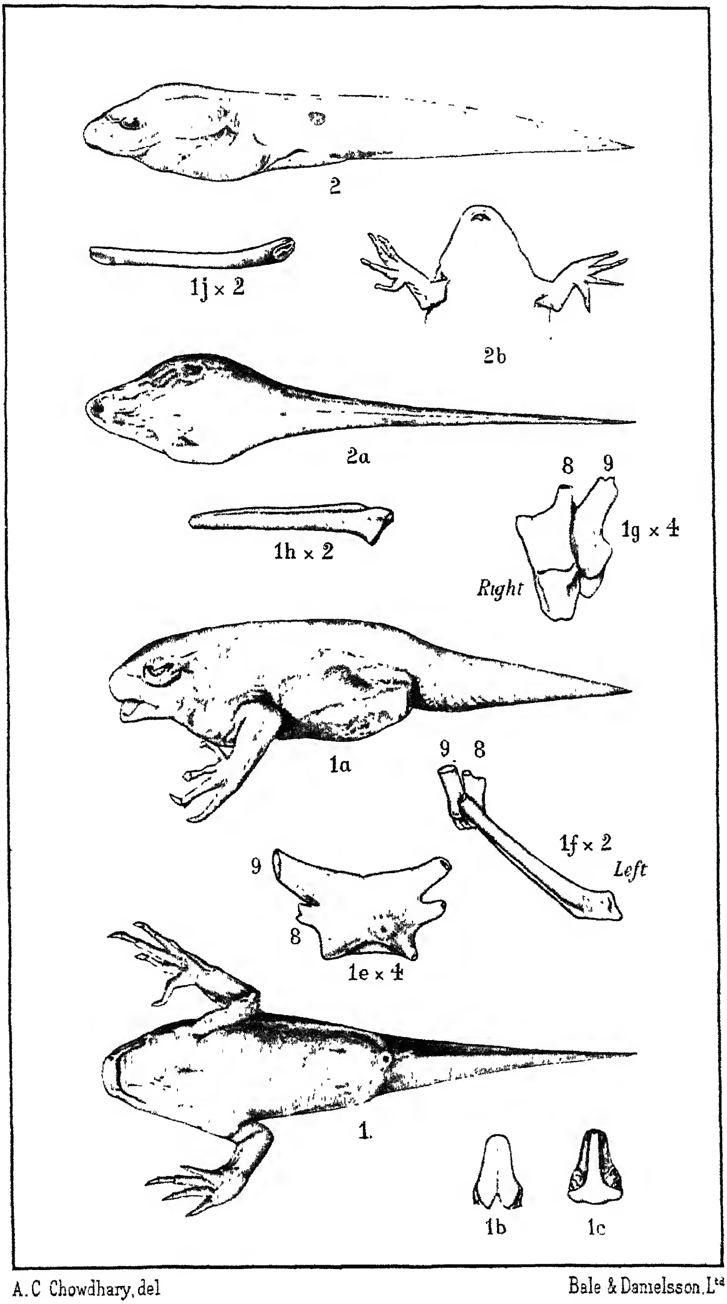
The two specimens on which the following notes are based were found in a bottle of miscellaneous specimens in the Indian Museum, which had been purchased in 1893 and were said to have come from Northern Cachar, in Assam. Unfortunately no information can be obtained as to the environment in which the tadpoles (which are not in a good state of preservation) were found. They were the only Batrachians in the bottle, but the Museum also possesses a number of specimens from Tenasserim of what I take to be the normal form of the same larva. Some of

* Forbes, "On the Male Generative Organs of the Sumatran Rhinoceros," Trans. Zool. Soc. vol. xi. p. 107.

† Beddard & Treves, "On the Anatomy of the Sondaic Rhinoceros," Trans. Zool. Soc. vol. xii. p. 195.

‡ Communicated by G. A. Boulenger, V.P.Z.S.

§ For explanation of the Plate, see p. 61.



A. C Chowdhary, del

Bale & Danielsson, Ltd

ABNORMAL RANID LARVÆ.

these have been submitted to Mr. G. A. Boulenger, whom I have asked to add a note as to their identity. I need only say that they appear to belong to the genus *Rana* *. My observations are of necessity confined to the external appearance and osteological characters of the abnormal specimens, with a general consideration of their visceral anatomy, for their muscular tissues are too decomposed for proper investigation. Even cartilaginous structures have degenerated greatly.

As regards visceral anatomy, the more advanced of the two tadpoles (which I shall call A) has an alimentary canal resembling that of a young frog, well-developed and apparently healthy. The tongue and palate are as in an adult. The lungs are large, extending nearly to the posterior end of the body-cavity; the kidneys seem to be normal, but I cannot trace any part of the generative system. The heart and larger blood-vessels are apparently normal. The condition of the viscera is less advanced in the other specimen (B), in which the mouth is that of a typical Ranid larva, except that there are no horny teeth. The intestine is still coiled in a spiral, and the lungs are small.

It is in the structure of the limbs and axial skeleton that the main abnormalities are found in both specimens. Figs. 1, 1 *a*, 2, 2 *a*, of Pl. VI., show that there is no hind limb in either specimen, and that while the fore limbs are well-developed in A, they can be seen through the skin in B.

The dimensions of the two specimens are:—

	A.	B.
	mm.	mm.
Total length	78	82
Snout to vent	42	28 (ap.).
Tail	35	54
Right arm	30	16
Left arm	25	17

Before dissecting A, I was led by deceptive appearances to believe that the hind limbs were developed beneath the skin, and I have to thank Mr. G. A. Boulenger for suggesting a further examination, which showed that I had been wrong in this belief. A dissection of the pelvic region led to an examination of the skull and vertebral column of A; in B I could find very little, owing to the fact that its skeleton had been chiefly cartilaginous.

Although the head of A looked like that of a young frog, the lower jaw was quite unossified and soft, and the cranium was in a very simple condition. The cranial box was well ossified above and on the sides, the bone being stout and sculptured on the surface. Its floor was represented by a delicate membrane, through which the remains of the brain could be seen. Below this, but not in close contact with it, lay a large, well-ossified

* [They are undoubtedly referable to *Rana alticola* Blgr., of which larvæ are figured in the Brit. Mus. Catalogue of Batrachia Ecaudata, p. 63.—G. A. B.]

parasphenoid, extending along nearly the whole length of the cranium. The auditory capsules had fused with the cranium and were well-developed, although there was no external tympanic membrane visible. The orbital arches were not formed, but the structures connected with the gills had entirely disappeared. The dorsal surface of the cranium is divided longitudinally by a simple suture, which expands behind into a wedge-shaped cleft.

The first seven vertebræ are normal in structure and, with the exception of the neural spine, thoroughly ossified; those of the tail are imperfectly ossified and retain their identity. The eighth and ninth vertebræ are abnormal; they are fused together, the anchylosis being complete on the dorsal surface but incomplete on the sides and below. The dorsal surface is nearly flat, but a slight ridge can be detected running along the mid-dorsal line, and there is a small mound-like elevation towards the left side on the eighth vertebra. The transverse and articular processes are deformed and asymmetrical in a manner and to a degree best shown in Pl. VI. figs. 1 *e*, 1 *f*, 1 *g*.

On the right side the only trace of the pelvic arch that can be distinguished is a minute, irregularly-shaped fragment of bone imbedded in a broad ligament which is attached at one end to the right transverse process of the ninth vertebra and ends in the muscles of the body-wall at the other. On the left side, in the corresponding position, there is a sac lined with connective tissue in the body-wall; it does not communicate either with the exterior or with the body-cavity. Its shape is an elongated oval, sloping from near the dorsal surface forwards and downwards towards the belly in front of the vent. A hernia, not strangulated but containing a portion of the intestine, projects into it in front.

Lying in this sac, but terminating above and below in the body-wall, is a sickle-shaped bone, which appears to have been provided with muscles not continuous with those of the body-wall. Unfortunately they are much decomposed. The bone is only fixed to the walls of the sac by adhesions of connective tissue. Above it is attached to the left transverse process of the ninth vertebra by a ligament resembling that on the right side. It slopes downwards, forwards and inwards, terminating in an expansion lodged in the muscles of the belly just in front of the vent, which has a mesial position. Its curve is slight, as is shown in fig. 1 *j*, which represents it as seen from in front when held vertically; fig. 1 *h* gives a view of the inner surface when the bone is lying in a horizontal position. The relationship between it and the eighth and ninth vertebræ is accurately represented in fig. 1 *f*, but the ligament has been omitted.

Considering the form and relationships of this bone, there can be no doubt that it represents the left ilium, though its position and forward slope are abnormal. The ligament which attaches it to the vertebra must represent not only its own head but also the distal extremity of the transverse process. The fragment of bone and the ligament on the other side of the body similarly represent

the corresponding bone on the right. A distorted fragment of cartilage in the muscles of the belly near the inferior termination of the left ilium represents the os pubis; but I can find no trace of the remainder of the pelvic girdle or of the skeleton of either leg.

The skeleton in B seems to have been entirely cartilaginous and is so distorted that no satisfactory account of it can be given. I can find no trace of the pelvic girdle or the hind limbs.

The fore limbs in A are well developed but not symmetrical. The right hand, measured from the wrist to the tip of the 3rd (morphologically the 4th) finger, is 17 mm. long; the left only 15 mm. Otherwise the limbs appear to be normal. The pectoral girdle is naturally to a great extent cartilaginous. In abnormal larvæ of the kind it is difficult to know what stage of development to expect in any given organ or structure; but, on the whole, I do not think that this girdle is so advanced in development as the condition of the arms and of the first seven vertebræ would lead one to expect. It is quite symmetrical and not remarkable in any other respect.

In B the fore limbs lay on the chest beneath the skin, which had ruptured in the region of either hand. I do not think that the spiracle had persisted, and both of the apertures may have been posthumous or of traumatic origin. The arms were readily freed by cutting through the skin. The measurements of them given above were taken after this had been done. Their bones appear to be more fully ossified than those of the remainder of the skeleton.

To sum up:—These two tadpoles, evidently belonging to the same species and possibly taken together, are abnormal in the absence of the hind limbs and, in at least one case, in the partial suppression, distortion, and asymmetry of the pelvic girdle. In the same specimen there is a less remarkable deformity of the fore limbs and the cranium is in an extremely primitive condition.

The drawings for the Plate have been prepared under my supervision by Babu A. C. Chowdhary, to whose accuracy I am indebted. No attempt has been made to depict the specimens in a natural condition; they are represented as they were found in the Museum. The bodies are shrivelled and distorted, and probably the fin-membranes, at any rate in B, were more extensive during life. The ventral integument in this specimen is torn, and I cannot locate the position of the vent with certainty.

EXPLANATION OF PLATE VI.

Abnormal larvæ of *Rana alticola*.

Figs. 1, 1 *a*.	A from the right side and below. Natural size.
Figs. 1 *b*, 1 *c*.	Cranium of A from above and below. Natural size.
Fig. 1 *e*.	8th and 9th vertebræ of A from above. × 4.
Fig. 1 *f*.	Do. from left side, with left ilium in natural position. × 2.
Fig. 1 *g*.	Do. from right side. × 4.
Figs. 1 *h*, 1 *j*.	Left ilium of A. × 2.
Figs. 2, 2 *a*.	B from the right side and below. Natural size.
Fig. 2 *b*.	Arms of B dissected out. Natural size.

2. On a Second Collection of Fishes made by Mr. S. L. Hinde in the Kenya District, East Africa. By G. A. Boulenger, F.R.S., V.P.Z.S.

[Received December 29, 1904.]

(Plate VII.*)

Nearly three years ago † I had the pleasure of reporting on a small collection of Fishes made by Mr. S. L. Hinde in the Mathoiya River, among which were examples of four new species. The British Museum is indebted to Mr. Hinde for a second collection made in the Kenya District, partly again in the Tana River system, partly in the wholly unexplored Nyiro River system, which takes its source in the Aberdare Range and loses itself in the Lorian Swamp. This second collection contains examples of only five species, two of which had been previously discovered by Mr. Hinde, the three others being new to Science.

1. Discognathus hindii, sp. n. (Plate VII. fig. 1.)

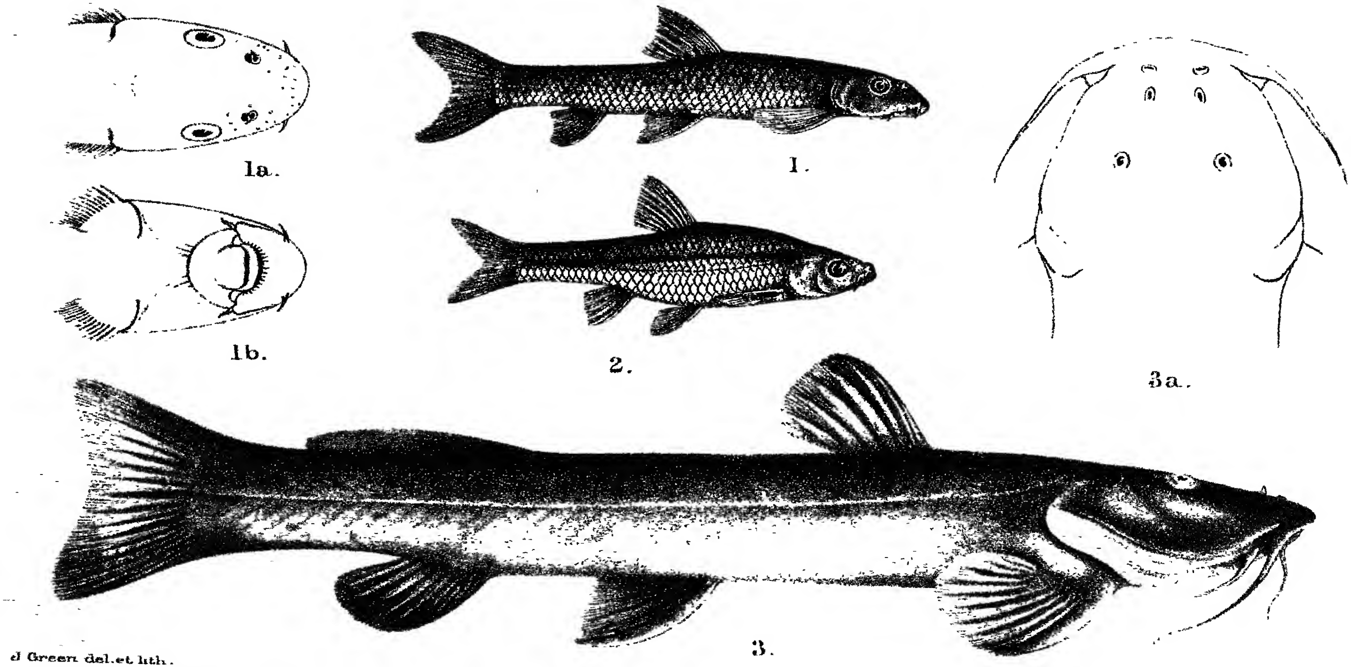
Body feebly compressed, its depth 5 to $5\frac{1}{2}$ times in the total length. Head broader than deep, once and $\frac{1}{3}$ to once and $\frac{1}{2}$ as long as broad; snout rounded, projecting very strongly beyond the mouth; interorbital region flat, its width not quite half the length of the head; eye supero-lateral, not visible from below, in the middle of the length of the head, its diameter 4 (young) to 5 times in the length of the head and twice to twice and a half in the interorbital width; width of mouth about $\frac{2}{7}$ the length of the head; upper lip well developed, fringed; lower lip forming a mental disk which is broader than long; two barbels on each side, measuring $\frac{1}{2}$ to $\frac{2}{3}$ the diameter of the eye. Dorsal equally distant from the centre or the anterior border of the eye and from the root of the caudal; first branched ray longest, as long as the head or a little shorter. Anal II 5, first branched ray longest, about $\frac{2}{3}$ the length of the head. Pectoral nearly as long as the head, not reaching the ventral, which is situated below the middle of the dorsal. Caudal fin deeply emarginate, as long as the head. Caudal peduncle once and $\frac{1}{3}$ to once and $\frac{1}{2}$ as long as deep. Scales 38–42 $\frac{5\frac{1}{2}-6\frac{1}{2}}{7\frac{1}{2}-8\frac{1}{2}}$, $3\frac{1}{2}$ or 4 between the lateral line and the ventral, 16 round the caudal peduncle. Dark olive above, whitish beneath; usually a few black spots on the base of the dorsal fin; young with a more or less distinct yellowish, dark-edged bar at the root of the caudal fin.

Total length 70 millimetres.

Numerous specimens from the head-waters of the Nyiro River, at an altitude of 7000 feet.

In these 'Proceedings' for 1903 (ii. p. 531) I have given a synopsis of the African species of *Discognathus*. The species now added is most nearly allied to *D. blanfordii*, which has a lower number of scales in the lateral line.

* For explanation of the Plate, see p. 64. † P. Z. S. 1902, ii. p. 221.



J Green del. et lith. Mintern Bros imp.

1. DISCOGNATHUS HINDII. 2. BARBUS THIKENSIS. 3. AMPHILIUS GRANDIS.

2. Barbus thikensis, sp. n. (Plate VII. fig. 2.)

Depth of body equal to length of head, $3\frac{1}{2}$ to $3\frac{2}{3}$ times in total length. Snout rounded, as long as the eye, which is contained $3\frac{1}{2}$ to 4 times in length of head; interorbital width $2\frac{1}{2}$ to $2\frac{2}{3}$ times in length of head; mouth small, terminal; lips feebly developed, lower interrupted on the chin; barbels two on each side, anterior $\frac{2}{3}$ length of eye, posterior a little shorter than eye. Dorsal III 7, equally distant from eye and from root of caudal, with a straight or slightly convex border; last simple ray bony, strongly serrated, about $\frac{3}{4}$ length of head. Anal III 5, longest ray $\frac{3}{5}$ length of head. Pectoral $\frac{2}{3}$ to $\frac{3}{4}$ length of head, not reaching, or nearly reaching ventral; latter below anterior rays of dorsal. Caudal peduncle twice as long as deep. Scales 33–35 $\frac{5\frac{1}{2}}{6\frac{1}{2}}$, 3 or $3\frac{1}{2}$ between lateral line and base of ventral, 12 or 14 round caudal peduncle. Brownish, with a more or less distinct dark streak along the middle of the side; lateral line often blackish; fins grey; a blackish spot sometimes present at the base of the anal fin.

Total length 55 millimetres.

Numerous specimens from the Thika River, Tana system, 3000 ft.

This species agrees very closely with the description and figure of *B. gibbosus* Peters*, which differs principally in having the caudal peduncle more than twice as long as deep. The name *gibbosus* being preoccupied (Cuvier and Valenciennes), I propose to designate Peters's *Barbus* from the Zambesi as *B. longicauda*.

I also avail myself of this opportunity for changing the name *Barbus miolepis*, which I bestowed on a species from the White Nile in 1893, but which is preoccupied by a Congo species, to *B. werneri*, in honour of Dr. F. Werner, who has recently rediscovered the fish at Wady Halfa.

3. Barbus hindii Blgr.

Fort Hall, Kenya (Tana system), 4400 feet. Grows to a length of 390 millimetres.

4. Barbus perplexicans Blgr.

Fort Hall and Thika River. Grows to a length of 350 millimetres.

5. Amphilius grandis, sp. n. (Plate VII. fig. 3.)

Depth of body $5\frac{1}{2}$ to 6 times in total length, length of head 4 to $4\frac{1}{3}$ times. Head not or but slightly longer than broad; eyes small, in the second half of the head, $2\frac{1}{2}$ or 3 diameters apart; interocular width $\frac{1}{2}$ or $\frac{3}{5}$ length of snout; latter broadly rounded, projecting but slightly beyond lower jaw; posterior nostril midway between eye and end of snout; præmaxillary teeth forming a crescentic band, measuring $\frac{1}{2}$ or $\frac{3}{5}$ width of mouth; maxillary barbel measuring about $\frac{2}{3}$ length of head, nearly reaching root of pectoral; outer mandibular barbel $\frac{1}{2}$ length of head, inner $\frac{1}{3}$. Dorsal I 6, in the middle of the space between bases of pectorals

* Reise n. Mossamb. iv. p. 52, pl. xi. fig. 2.

and ventrals, equally distant from end of snout and from middle of adipose fin; first branched ray $\frac{1}{2}$ length of head. Adipose fin 5 or 6 times as long as deep, twice and $\frac{1}{3}$ as long as rayed dorsal. Anal III 6, midway between root of ventral and root of caudal. Pectoral a little longer than ventral, $\frac{2}{3}$ length of head. Caudal moderately emarginate. Caudal peduncle as long as deep. Olive-brown above, with very indistinct darker marblings, brownish white below.

Total length 180 millimetres.

Three specimens, from the Chania River of Tetse, Tana system, in cold water, at an altitude of 7000 feet.

This new *Amphilius* is the largest yet described, exceeding in size the *A. longirostris* of South Cameroon (originally described from an immature specimen), which grows to a length of 140 millimetres.

The genus *Amphilius* Gthr. (*Anoplopterus* Pfeff., *Chimarrhoglanis* Vaill.), until quite lately represented by two known species only, now includes as many as seven, the characters of which may be thus contrasted:—

I. Dorsal above the space between pectorals and ventrals.

A. Head not or but slightly longer than broad; snout broadly rounded, its length not more than twice interocular width; base of adipose fin much longer than that of rayed dorsal.

Length of head at least 5 times in total length; maxillary barbel extending beyond posterior border of head; caudal peduncle not longer than deep . . . . *A. uranoscopus* Pfeff. 1896.

Length of head 4 times in total length; maxillary barbel not reaching posterior border of head; length of snout once and $\frac{2}{3}$ to twice interocular width; caudal peduncle not longer than deep . *A. grandis* Blgr. 1905.

Length of head 4 to $4\frac{1}{2}$ times in total length; maxillary barbel not extending beyond posterior border of head; length of snout once and $\frac{1}{3}$ to once and $\frac{1}{2}$ interocular width; caudal peduncle longer than deep . . . . *A. platychir* Gthr. 1861.

B. Head longer than broad; snout obtusely pointed, its length 2 (young) to 3 times interocular width; base of adipose fin not more than once and a half that of rayed dorsal *A. longirostris* Blgr. 1901.

II. Dorsal above the ventrals.

Length of head 4 to $4\frac{1}{2}$ times in total length; snout broadly rounded; interocular width $2\frac{1}{2}$ to 3 times diameter of eye; caudal peduncle a little longer than deep; caudal forked, with rounded lobes . *A. atesuensis* Blgr. 1904.

Length of head $3\frac{2}{3}$ to $3\frac{3}{4}$ times in total length; snout broadly rounded; interocular width $2\frac{1}{2}$ to 3 times diameter of eye; caudal peduncle as long as deep; caudal feebly emarginate . . . . . *A. brevis* Blgr. 1902.

Length of head 4 to $4\frac{1}{2}$ times in total length; snout pointed; interocular width not greater than diameter of eye; caudal peduncle more than twice as long as deep; caudal emarginate . ... *A. angustifrons* Blgr. 1902.

EXPLANATION OF PLATE VII.

Fig. 1. *Discognathus hindii*, p. 62.
1 *a*. „ „ Upper view of head.
1 *b*. „ „ Lower view of head.
2. *Barbus thikensis*, p. 63.
3. *Amphilius grandis*, p. 63.
3 *a*. „ „ Upper view of head.

3. Notes on the Mammals of Southern Cameroons and the Benito. By George L. Bates *.

[Received January 10, 1905.]

It does not seem worth while to repeat here the description of the Cameroons-Gaboon forest given in connection with Dr. Sharpe's paper on the Birds of this Region in 'The Ibis' (1904, pp. 592–595). But it is necessary to bear in mind that the whole face of the country is absolutely covered with forest, consisting of tall trees standing close together, with the spaces between their stems filled with saplings and underbrush, and the whole bound together by vines and creepers, many of them thorny. This mass of vegetation excludes the sunlight, except in rare openings or rifts. Walking through it is difficult, except by following the paths. Clearings have been made for villages and plantations, and these when abandoned do not immediately return to forest, but for several years are possessed by a thicket of grass, bushes, and small trees of quick growth. Thus in the more thickly inhabited parts of the country there are considerable areas covered by this smaller growth instead of forest. But as these are near villages of men, and are avoided by the large animals, they may be almost ignored in considering the nature of the country as a habitation for mammals, though they are the favourite haunts of many birds.

The dense and impenetrable nature of the forest, with but few human dwellings and paths, makes it an admirable hiding-place for animals of all kinds. Furthermore, the fact that everything larger than a mouse or a sparrow, whether beast, bird, or reptile, is constantly hunted for food by the natives, makes the animals afraid of man. Hence it comes that observation of animal life is peculiarly difficult here. The statement is often made with reference to the animals of West Africa, in books of Natural History, that almost nothing is known of their habits in the wild state, because travellers have failed to record their observations. But the truth seems to be that travellers have seen little to record.

The remark has been made by more than one person who has journeyed through this forest region, that animal life in it is scarce; yet it really abounds in wonderful variety. Comparatively few white men, and not all natives, have seen an Elephant in this country; yet their trails through the forest, the broken and uprooted trees where they have been feeding, and even the mud-puddles where they have wallowed, are often seen. Leopards may be said to abound, judging from their ravages among domestic animals, and the frequency with which their tracks or droppings or leavings of their prey are found in the

* Communicated by Oldfield Thomas, F.R.S., F.Z.S.

forest; yet, except in a few cases where they have been trapped, no white man I know has ever seen one alive. No white man I know ever saw a Buffalo; but their tracks are often seen, and natives sometimes kill them and sometimes are killed by them.

The Red River-Hog does great damage to crops, and many of them are killed by the natives with their guns and in pitfalls; yet I never distinctly saw one running wild, though I have often heard them, and seen places where they had been.

It is doubtless true that one walking along the paths through the forest is never far from a company of monkeys feeding in the tree-tops; but a person who is not thinking of monkeys may sometimes go many days' journey without catching a glimpse of one. No white man I know has ever seen a Gorilla wild, plainly enough to be sure that that was what he saw; yet in certain localities there are, at times, many of them. I once tramped around with a native guide for several days, seeing recent tracks of Gorillas and beds where they had slept, without once meeting one.

The natives of the country hunt the animals for food, and have the inherited keenness of sight and hearing of savages, improved by practice, the immense advantages of dark skins, rendering them inconspicuous in the darkness of the forest, and a noiseless step, by which they can approach game without alarming it; they thus learn far more about the animals of the country than any white man learns. I have no doubt that most of the scanty information hitherto published about animal life in the Guinea forest has been obtained from natives. Even Du Chaillu, who gained more knowledge of this forest than any other man, must have based his accounts on information obtained from natives. It was the opinion of some of the old missionaries, whose guest he was at times while in Africa, that many of the adventures he relates were taken from the hunting-tales of natives, and that, although in representing them as his own personal adventures he may have been untruthful, he probably took conscientious care to tell only what he believed really had happened to some one, and hence was not untruthful where the facts of natural history were concerned.

These remarks about the difficulty of observing animal life here are intended to furnish some excuse for the scantiness of the information in the notes that follow. They are intended also as an apology for recounting things told by natives. Of course not everything told by natives has been accepted as true. A tendency to exaggerate could be detected by comparing different accounts; and sometimes statements in which all accounts agree were found to be the least trustworthy of all, since they were found to be merely taken from tradition and not from actual observation, like many popular beliefs about animals among white races. But such worthless statements should be sifted out, and the statements here given from native testimony are such as seem worthy of belief.

Before coming to notes about particular animals or groups of

animals, one more peculiarity about the nature of the forest may be mentioned here, and that is the way in which the colouring of certain animals is adapted to make them invisible or inconspicuous in it. It is a matter of common observation by all who practice shooting in this forest, that the dark skin of the naked native men is better fitted to make them inconspicuous than any sort of clothing a white man may wear. The dark colouring of many animals doubtless has the same effect. But an acquaintance with the forest shows also the more remarkable fact that animals with spots or patterns of dark and bright colours, like Leopards, Monitor Lizards, Snakes, &c., are perfectly adapted to escape observation so long as they are motionless; for the dark and sombre ground-colour, formed by the dead leaves on the ground and the black stems of trees, is dotted with innumerable bright spots. In rainy weather the light glistens from the wet leaves, both above and below; and in fair weather the sunshine, where it gets through the foliage at all, makes bright flecks on the dark ground and trees. Then there are other bits of brightness: sometimes golden-yellow flowers grow right out of the black tree-trunks, yellow fungi deck the decaying logs, yellow withered leaves may at all seasons be seen among the black and brown ones on the ground. Some trees have sap of an intense yellow colour that flows out and makes yellow streaks or blotches below every cut or insect-puncture in the black bark.

Another thing must often serve to make the red wild hog inconspicuous; that is, the red colour of the soil. I have seen bare places on the ground, as in a path, or where a tree has fallen tearing up the soil with its roots, where the Red River-Hog might lie and not be noticed because it was of the same colour as the ground, and in some of such places hogs had actually recently lain.

THE GORILLA (*Gorilla*).

Gorillas generally keep to the depths of the forest. When they come into the outlying clearings of human settlements, it is because they are attracted by some fruit or succulent plant. The commonest attraction is the fruit of a tall cane-like endogen (?*Amomum* sp.) growing thickly on abandoned garden-land. At one very small isolated village the people told me that they often both saw and heard Gorillas, which actually sometimes came and broke down the plantain-stalks behind the village, to eat the tender heart. At that village there were only two or three men, and they had no guns.

Usually Gorillas are very wary when they approach human dwellings. Once I spent several days, with a native guide, tramping about in old clearings overgrown with "mejom" (the cane-like plant above-mentioned), looking for Gorillas. We saw many tracks, showing the imprint both of the soles of the hind hands or feet and of the backs of the fingers of the front; we saw also many hulls of the fruits of "mejom," and shoots torn

open and the tender inside eaten; and we saw many old beds of "mejom"-stalks broken down and matted together; but we did not get sight of a Gorilla. The tracks and beds on that occasion showed that there was a family of three or four individuals there, some of them small. On another occasion I saw a single bed, that had been used by a solitary Gorilla only the night before. A woman had heard the animal the evening before, breaking down the stalks for his bed. I was told that Gorillas sleep on these beds, which are thick enough to keep them a foot or two up from the ground, in a sitting posture, with the head bent forward on the breast. The people say they sometimes hear them snore. Even when sleeping Gorillas are hard to approach, as they waken easily. An attempt, made at early dawn, to surround the one the woman heard making his bed was unsuccessful.

In most of the cases of which I have heard, of Gorillas being killed by natives, they were met with accidentally in the daytime, on the ground or in low trees in the outlying clearings. Many natives do not venture to molest a male Gorilla, even when they see one, as he is dangerous when wounded. I was told of a boy having been killed by one, and I saw the severe wounds in a man's thigh made by the biting of a wounded Gorilla.

The only case of a white man's killing a Gorilla of which I know is that of the German trader Paschen, in the Yaunde country, to the north of where I have been.

They say the male Gorilla sometimes utters a deep gruff call, but I have not heard it.

The Chimpanzee (*Anthropopithecus*).

Chimpanzees are much more frequently killed by native hunters than Gorillas, and nearly always in the forest, not in clearings. When found in the forest, they are usually in companies of half-a-dozen or so, in the trees or on the ground. They often make a noise in the forest, which sounds very like the hallooing or excited talking of men. Once even my guide was fooled by them, and, on hearing them, inquired who those men hunting porcupines could be.

Once at a certain village, just as people were going to bed, a Chimpanzee was heard in the forest near by, making a most unearthly yelling. It slept in a tree near the village, and early in the morning men went out with bows, and punctured its skin with some poisoned arrows, before it had left its bed. When I went out a little later, I was shown the bed where it slept, made of branches broken and laid together, some 20 feet from the ground. The animal had by then retreated into the top of a very high tree, from which it could not escape except by coming nearer the ground, and this it was afraid to do on account of the people beneath. It was walking backwards and forwards along the branches, screaming and beating them with its palms; this it kept up for an hour or two. It then became stupid and sat still

for a few moments, when it slid off the branch, and first catching it with one hand and hanging a moment, it dropped to the ground, dead. It died about 8 o'clock, and must have been first shot with the poisoned arrows a little before 6.

This animal was wandering alone; it was an old male.

The Drill (and Mandrill ?).

The Bulu name "sek" is applied to the Drill. The name "zômbô" seems to signify a large old male of the same species; though possibly the Mandrill is found here also, and confounded with the Drill.

These baboons are not plentiful, and seem to keep to the depths of the forest, remote from villages. In such places they are often found in large companies, though they are sometimes seen only three or four together. I have seen a place where the dead leaves had been scratched around as if by hogs rooting, and been told that it was where a troop of "sek" had been feeding, hunting among the leaves for nuts or roots. I have seen places also where little shrubby stemless palms had been grubbed or pulled up by the roots, and this, I was told, was the work of "sek" that were seeking the tender terminal bud which, in the case of larger palms, is eaten by men.

Natives have told me that if a company of these animals is surrounded while on the ground, they cannot quickly escape by climbing trees; they are certainly not such agile climbers as the smaller monkeys, but they do climb trees. I have known all but one of a company of them, that were discovered in the tree-tops, to get away by running along the branches and hiding in the foliage, like small monkeys. I have been told that they sleep in the tree-tops, as other monkeys do.

A wounded male I saw looked very ferocious, and the native hunters seemed afraid he would kill a small dog they had. But I never heard them speak of the "sek" or "zômbô" as being dangerous to man.

A female killed in the month of August was accompanied by a sucking young one.

The Cercopithecus Monkeys.

The genus *Cercopithecus* comprises all the common species of Monkeys of this country. Shooting these monkeys affords much sport to white men who get out into the forest, and is the principal occupation of native hunters. They are not easily approached, for they have keen sight and hearing and are shy. They go about in small companies of a dozen or less, with one old male for leader. Often an old male is found alone, probably a defeated candidate for the place of leader, who has gone off by himself. The leader may often be heard calling in a loud, gruff, barking tone, to keep the company together. Except for the occasional call of the leader, the company feeds silently, and the

only sound that betrays the presence of monkeys is the rustling of boughs as they pluck fruits or jump from branch to branch. Only when they discover the hunter and become frightened, do they utter a little cackling sort of chatter; then they scurry away, and if they are in thick foliage they hide and remain hidden securely as long as the hunter has patience to wait for them to come out. But if they are in an open tree they may be shot while running, if a man is quick enough. If the leader has passed ahead, sometimes the others will venture out in plain sight, in order to follow him.

These monkeys very rarely come to the ground; I myself have never seen one on or even near the ground, except when wounded. They can pass from the branches of one tree to those of another, not touching it, by jumping; they jump upon and grasp the swaying outmost twigs, which bend far down with the weight, and then spring up. The monkey merely holds on as the branch sways down, but with the rebound he scrambles along to the larger branches. Monkeys can cross any but the largest rivers in this way, on the nearly meeting tree-tops.

These monkeys sleep in the trees, but do not make rude beds of the branches as does the Chimpanzee. I have asked many natives how monkeys manage to keep from falling while asleep, and the answers are various. But there seems probability in the account that they sleep sitting, and holding on to branches or to each other.

The habits of the three commonest kinds of *Cercopithecus* are very similar, and what is said above applies to all of them. The "ôsôk" (*C. cephus*) seems to be the most nimble, and the white-nosed "avemba" (*C. nictitans*) the least so; the latter kind is rather oftener killed than the others. Different kinds are often found together in the same company. The calls of the three kinds, the two mentioned and the "ésuma" (*C. erxlebeni*), are very much alike, but one can learn to distinguish them.

The habits of the little "ôzem" (*C. talapoin*) differ in some respects from those of the other kinds. It is never found far from a large stream of water, and generally keeps to the trees on the very banks of streams. At villages situated near rivers I have been told that these little monkeys steal corn from the gardens. They are quicker in their movements even than the others. Their call is very different, being a little explosive "k-sss!" that sounds like the splash of a stick thrown into the water.

The only remaining species of *Cercopithecus* that I collected is *C. neglectus*, called "avut" or "fuñ." I obtained it only near the river Ja, as I did also *Cercocebus agilis*, called "nsak." But I heard of them both on the Benito. They seem to be found only near large rivers. Hunters at the Ja told me that they find both these kinds only on the banks of streams. They hunt them on a small tributary of the Ja, near its mouth, by wading in the stream when the water is low.

I obtained a number of specimens of embryos taken from the bodies of monkeys killed by natives. These were mostly brought in May, June, and July, though some came also in October and November.

Other Monkeys.

The monkeys I have collected, not of the genus *Cercopithecus*, are *Colobus satanas* and two species of *Cercocebus*, besides *Cercocebus agilis* mentioned above.

The Colob is of local distribution, and I know nothing to tell about it except some doubtful statements of natives. The same is true of the *Cercocebus* called "kak" (? *C. albigena*).

The "éka'afuñ" (*Cercocebus collaris*) is a little better known. Monkeys of this species are not rare, but are not often killed. They differ from those of the common kinds in that they often descend to the ground to feed. Their call is very different from that of the *Cercopithecus* monkeys. It is rather shrill, and ends in an after-sound like that made while drawing in the breath or gasping.

The Galago Lemurs.

These little creatures have a wonderfully tight grip; their clammy flattened fingers resemble the toes of tree-frogs.

The "émam" (*Galago alleni*) is found in the daytime in hollow trees, three or four huddled together asleep. The little "ôjam" (*G. demidoffi*) is similarly found asleep, three or four huddled together in old nests of the squirrel "ôsen." Some people have told me that the little Lemurs make their own nests, but it seems more likely that these are only old squirrels' nests. The other species, *G. pallida*, called "nsaé," uses neither hollow tree nor old squirrel's nest for a hiding-place in the daytime. They are found sleeping in bunches of as many as half-a-dozen, clinging with their arms around each other's bodies and around the branch of a tree. A shrill squeaking or chirping, often heard at night among the tree-tops of the forest, is referred by the natives to the "nsaé." They say that this noise is heard oftener near morning, and that then the "father" is calling together the rest of the company, to gather them into a huddle for the daytime.

An "ôjam" that I kept alive once for several days made a chirping noise at night, as shrill as that of a cricket. In grasping anything with its hind hand, the clawed finger was always folded in the palm, under and not over the thing grasped.

An "émam" that was brought to me alive showed great powers in jumping. A monkey can jump outwards and downwards and catch a branch, but this *Galago* could jump out and up and catch hold of a branch. It died in the hot sunshine when I was away from camp; it had probably never felt sunshine before.

The Pottos.

The two or three species of *Perodicticus* of which the names

have been sent to me I have not learned to distinguish with certainty; in the little I have to say about them I must mention them together.

They are found in the daytime curled up asleep in the trees, tightly clinging to a branch. So tight is their grip of the branch that specimens have sometimes come to me mutilated in the hands, the natives who captured them declaring that it was only by cutting the fingers that they could loosen the animal's hold.

Pottos are sometimes caught in traps placed on a horizontal pole or bridge crossing an open space between two pieces of forest, such as a narrow place in a garden clearing or a stream. The animal crosses on the pole in preference to descending to the ground. One specimen was killed at night on the roof of a house, to which it seemed to have wandered from the overhanging plantain-tops.

A suckling female was caught in January, along with a half-grown young one.

The single specimen of *Arctocebus aureus* that I sent to the museum is the only one of this animal I have ever seen. I found it in a village on the Benito River, where it had just been killed by a native, who did not know what to call it. However, I have sometimes heard from natives of a rare beast like the Potto, which must be the same.

The Fruit-eating Bats.

The commonest species of *Epomophorus* (? *E. franqueti*), called "éndem," probably makes more noise at night than any other creature of this country. Their monotonous croaking racket may be heard in the bush-growth about villages any night—at least if any of the wild trees growing in such places are in fruit. They were especially abundant about my house when an "Udika" tree near by was bearing. Their noise, consisting of a sort of croaking bark repeated many times in a monotone, was generally heard coming from a thicket where the bat seemed to be hanging. But sometimes, at dead of night, the sound was heard passing overhead, from a bat flying. Whenever a bunch of ripe bananas was hanging on my porch, it was visited by the bats at night. When the bananas got very soft, the bats would eat several of them in a night and bite many more. They took their bites on the wing while flying to and fro.

Boys would sometimes find these bats hanging on bushes in the daytime. On the last day of August and the first of September two females were brought to me, each with a half-grown young one, which had been found clinging to the mother.

The big *Hypsignathus monstrosus* was very abundant in the mangroves and palms along the banks of the Benito River, where it made a noise like that of the "hindem," but still louder. In the Bulu country, where there are no large streams, they are not common, but are sometimes found hanging in the forest,

especially in swampy places. One so found was discovered through the little birds twittering around it, as they do around an owl or a snake.

The Horseshoe Bats.

The big *Hipposideros commersoni* I have sometimes seen flying about over villages at evening twilight, catching insects in the air. While doing this it makes a little squeaking sound in a very high key, that some people (natives) said they could not hear.

Hipposideros cyclops is very frequently found in hollow trees, along with *Idiurus* and some species of *Muridæ*.

One or two species of *Nycteris* have been found also in hollow trees.

The Vespertilionidæ.

The little Bats of this family are generally found hanging on bushes in the daytime, or seen flying around villages at evening. Some of them seem to be partial to the plantains and bananas at the back of villages, hiding under the big leaves.

Two adults and a young one (in the month of October) were caught together, entangled in a spider's web.

One very little bat was found in a knot-hole in a small tree that had been cut down and carried come distance to form the post of a house; the little bat had not been disturbed by the cutting or the carrying of the tree, and was found by boys who were peeling the bark.

The Wrinkled-lipped Bat.

The Bat called "éfefaé" is a member of the genus *Nyctinomus.* "Bifefaé" are found in the holes bored in dead tree-trunks by the Barbets called "ôvôl" (*Heliobucco bonapartei*). The bats and the birds seem to live in the holes at the same time. They are so often associated that the white eggs of the Barbets are said by the natives to hatch out Bats.

The large *Taphozous peli* was obtained only on one occasion, near the Benito River, and must be rare or local.

The Potamogale.

Most of the specimens I have obtained of the "jes" (*Potamogale velox*) were caught in snares set on the banks of streams, at places were the animal's excrement was seen. It seems to have the habit of resorting always to a certain spot to void excrement. The "jes" is also occasionally killed by women when fishing out little pools in the streams. When one is discovered in the pool it is surrounded, and all the women strike at it with their cutlasses as it darts hither and thither in the water, till it is killed. One specimen (a pregnant female) was said to have been dug out of a hole in the bank of a stream.

Two rather small young ones, also said to have been dug out of a hole in a bank, were brought to me in the month of March. They lived three days, drinking a little milk, and one of them eating also bits of boiled egg, which it seized in its mouth with a sudden motion, as if afraid they would get away. When not curled up asleep they were continually squirming and gliding over each other with a motion that made one think of snakes. Their movements were very quick. They occasionally uttered a little squeaking noise.

As to the time of breeding, it may be remarked that two females, each with embryos in the body that would have been born in a short time, were caught in the month of June.

The Leopard (*Felis pardus*).

As already stated, traces of Leopards are often seen, and their ravages are frequent, though they are seldom seen themselves. When the natives do find them in the forest, they are usually hidden in the closest thickets, and their presence is indicated by the alarmed chattering of squirrels and birds about them. Hunters often find partly-eaten carcasses that leopards have left. They say that of monkeys the Drill is most often found thus.

Leopards are said to hunt in pairs, a male and a female together. If three are together, they are a mother and two well-grown cubs. The she-leopard brings forth two cubs, sometimes three, in large hollow logs or hollows under rocks.

I have often seen droppings of leopards in the path. The kind of hair in them shows on what the leopard has been feeding. Sometimes the long roan hair of the tail of certain antelopes is recognised, and sometimes the quills of porcupines. I have seen the marks of leopards' claws on the bark of trees. Once a soft-wood tree on old cleared land was seen with scars of claw-marks in the bark at regular intervals clear up to the first branches, 15 or 20 feet from the ground. There appeared to have been two animals, and the natives with me remarked that the scars were made by a male leopard chasing a female up the tree.

The natives consider the flesh of the Leopard the best of eating.

The Civet (*Viverra civetta*).

I have more than once heard in a thicket in the forest a snarling noise like that of dogs fighting, and been told that it was made by two "bezoé." "Zoé" is the Bulu name of the Civet. I once saw a "zoé" trotting along in the forest with its nose to the ground, apparently smelling for worms or other creatures under the dead leaves.

The "zoé" hides also in the big grass (*Panicum maximum*) that comes up on old cleared ground about villages. A boy cutting grass on the outskirts of the Mission premises found an old white-whiskered female curled up asleep, and killed her with his cutlass.

She had milk in two teats; that was in October. In April a man showed me a young "zoé" the size of a two-week's-old kitten—one of three found in a lair not far from a village. About August a man shot a mother that had two or three little ones in a nest in the same big grass mentioned above.

The Civet visits the fields of growing corn (maize) at night, and breaks down the stalks and eats the tender ears. It prowls about chicken-coops at night, and sometimes catches poultry.

The Genet (*Genetta*).

The "nsiñ," as the Genet is called, is the greatest poultry thief of the country. From its proverbial shyness, it occupies the place in popular talk and tales that the fox does in Europe. It hides in the thick bushes about villages, ready to snap up any fowl that wanders too far away. But it is also an inhabitant of the big forest, for it is often killed far from any human habitation.

A female killed in January was suckling.

Poiana richardsoni.

This rather rare little beast is called "ôyan." It is found only in the forest, sleeping in the daytime on thick tangled vines, and walking only when disturbed. A female brought me in October had milk in two teats. A native hunter told me that the "ôyan" produces two young.

The Nandine (*Nandinia binotata*).

The Nandine, or "mvaé," lives on vegetable food, such as the fruits of the "aseñ" tree and the little gourd-like fruits of a vine (*Luffa batesii*), and these are used by natives to bait traps for catching it. It forages at night and sleeps in the daytime, in thick tangles of vines in the tree-tops. It is sometimes seen at dusk, either in the forest or in village clearings, creeping along the branches of a tree. One evening, at my camp in the forest, two were heard in the tree-tops near by, calling to each other in a small, faint voice, like a kitten mewing.

Though it is thus arboreal, it often runs around on the ground at night and also visits villages. It is frequently caught at night in dead-fall traps near villages. Once in a village where I was staying, happening to be up in the early morning before the people had come out of their houses, I saw a "mvaé" trotting along in the street. Another morning soon after that I noticed that something had been gnawing during the night at the bits of flesh left on a skeleton of a chimpanzee I had hanging up in the palaver-house to dry. The skeleton was hung farther away from the post of the house, but still the next night it was gnawed again, though the animal had to go along the under side of the ridgepole to reach it. The third night the bush-rope by which the skeleton was hung was lengthened, so that the animal had also to descend the bushrope; and still the skeleton showed in the

morning further marks of gnawing. The next night, after watching for it till past midnight, I had just gone to bed when the boy, who took my place watching, fired; he missed the animal, but he saw it, and it was undoubtedly a "mvaé."

Though that one was hunting for meat, there is no doubt that the usual food of the Nandine is vegetable. It never catches chickens, as do other *Viverridæ*.

Crossarchus obscurus.

Three young of this little animal, which is called "nyamesô'ô," were once brought to me by a man who said he found them in a hollow tree with the opening near the ground. They were probably two or three weeks old. They lived only a few days, though they drank a little milk and ate bits of meat and egg. First, one that looked puny at the beginning died. Then one of the others was accidentally killed, and the remaining one after that cried continually till it died. When awake and stirring, these little creatures made a little squeaking noise like the twittering of small birds. When running about on the ground they kept close together, one behind the other, generally with the nose of one touching the rump of the one ahead. Once, when a gun was fired not far off, the three instantly crouched down behind a stick at the sound.

Mr. Johnston, when hunting in the forest, once killed two of these little animals at one shot. He said they were making the same squeaking noise my young ones made. Native hunters say these animals always go in companies one behind the other, like my young ones, sometimes a dozen together; and that they root among the dead leaves and vegetable mould of the forest, looking for worms to eat.

The Mongooses.

The larger *Herpestes* (*H. naso*), called "mvak," is one of the small animals most frequently killed by the natives. Yet I have nothing to record about it except that it is found in the forest in swampy places or near streams, and is said to eat crabs.

The small *Herpestes gracilis*, on the contrary, lives not in the forest, but in the thick bushes about villages, and is seldom killed, though it does not seem to be rare. That it is so seldom killed seems to be because of its extreme wariness. It is a great poultry thief.

The *Bdeogale nigripes* seems to be found in the same kind of place as *Herpestes naso*, but more rarely.

The Larger Hoofed Animals.

The Hoofed Animals form the most interesting group from the sportsman's point of view. So it is with regret that I have to confess my failure to learn much about them.

The small Buffalo of this part of Africa, and the two species of

Antelope of the genus *Tragelaphus*, of which the larger is called "émvul" and the other "ñkok," all prefer the parts of the country in which there are open grassy places. Hence they are more common near the coast, where, for a mile or two back, there is much grass, than further inland, where there is scarcely a break in the forest; and far inland, where again there are extensive grassy places, they are likewise more frequently met with.

The Buffalo is not absent, however, from the most densely wooded parts of the country. Sometimes a number of them come to feed at night in the grassy sites of deserted villages. In such places some native hunters are bold enough to shoot them, but they do so at considerable risk to their lives. I have heard of more than one case of a man being killed by a Buffalo.

A large Antelope called "ézôna," of which I have seen strips of the skin and the spiral horns, must be the *Boocercus eurycerus*. I have heard of it only in the interior, about the River Ja.

The Duykers (*Cephalophus*).

The six species that I know of the genus *Cephalophus*, though they differ considerably in size and colour, are much alike in their habits. They are all inhabitants of the deep forest, coming around village clearings only when attracted by the growing crops. When the people find that their patches of maize or peanuts are being visited at night by antelope, they build light fences around them. A small gap is left in the fence, and a snare with a strong noose of vine is fixed in the gap. In this way they not only protect their crops, but often secure meat besides.

When anyone finds fresh tracks of one of these antelopes in the forest, he follows it to some thicket; and if he sees tracks entering and none leaving the thicket, he goes to the village and gets help. Then the men go with a long net they make and keep for the purpose, spread it in a suitable place, and try to surround the antelope and drive it into the net. Many are caught in this way. Many are caught also in pitfalls.

The red "sô" (*Cephalophus castaneus*) is reputed to be less wary than the others. It is sometimes found in the forest or the borders of clearings, lying curled up, asleep. "The sleep of the sô" is proverbial among the Bulu for soundness.

Young of different species of Duyker are often found asleep in the forest, where they have been hidden by their mothers. A female "sô" caught on September 25th would have brought forth one young in less than a month.

The commonest of these Duykers is the smallest one, the "ôkweñ" (*Cephalophus melanorrheus*). The next in abundance is the "mvin" (*C. callipygus*).

The Pigmy Antelope.

The diminutive "ôjoé" (*Neotragus batesi*), unlike the Duykers,

is found only in the vicinity of village clearings, and never in the depths of the forest. Hence it is most abundant in parts of the country where there are large and old settlements. Sometimes when it is seen and chased by natives in the grass or thick sweet-potato vines about villages, it becomes entangled and is caught. It is especially fond of eating the growing peanut-tops, and is caught in noose-traps set at the edge of peanut-patches.

The Chevrotain.

The curious little hoofed animal called "vioñ" (*Dorcatherium aquaticum*) is found only along the banks of streams of considerable size. The only use I have learned that it makes of the water is as a refuge when pursued. It is said to be unable to run fast like an antelope, and if found far from the water is easily caught by dogs. It is hunted by a company of men with dogs, as is the porcupine. The dogs start it up and the men run along the bank, and either intercept it, or, if it gets into the water, shoot it as it swims or stands with only its muzzle out.

The "vioñ" is said to make a rather loud noise, something between the little whistling bellow of antelopes and a loud grunt.

Its meat is very white and very tender.

The Red River-Hog (*Potamochœrus porcus*).

In July 1902 several little pigs just born were brought alive to the Mission. They had been found and caught in the forest, in one case four in a litter. In 1903 some were brought in August. Out of several that were brought to the Mission, the only one to survive was "Pet." He early took to human ways, and delighted in the company of the little native school-boys. He was fond of sleeping with them, and squealed angrily when shut up in his pen alone at night.

In his third month he had lost all his stripes, and was coloured like his adult kind. The stripes began to disappear low down on his sides when he was only two or three weeks old; the last stripe to go was the black one along the middle of the back.

When "Pet" was three or four months old, a companion was caught for him in the forest. This pig, a female, being about the size of "Pet," must have been born also about July. "Pet" had become so accustomed to human society that he would not own kinship with the new-comer; though in the same pen with her, he took no more notice of her than of an animal of another kind. She, in turn, did not take kindly to her surroundings, and when let out of the pen made for the "bush," and was not caught again.

As "Pet" grew large, he began to grunt or "mem," a peculiar emphatic sound of which the domestic pig's grunt is only a faint imitation. "Pet's" grunt expressed lusty strength and self-satisfaction, with the suggestion of a threat to any one who should molest him. As he grew he also developed carnivorous

propensities, in so far as to catch and eat chickens. When a chicken or well-grown hen approached too near, to share his corn, he whirled suddenly and caught her in his mouth. Then he learned to take fowls from the roost at night, and showed much ingenuity in getting into the chicken-house for the purpose. He became such a nuisance on this account that he was made into pork before he reached his full size.

The wild Red Hog's fondness for cassava-roots causes it to do much damage to the gardens. But what the people lose thus they more than get back in meat by killing the hogs in pitfalls dug where they must pass to get to the cassava. Once, in June, there were caught in two pits near the village where I was staying two adult males, one adult female, and three half- or two-thirds-grown young ones, probably nearly a year old. They belonged to one band, or "sounder," that was found in the day-time in the neighbourhood of a clearing, and was surrounded by men and driven into the pits.

These wild hogs forage both by day and by night. Their incursions into the gardens are generally made at evening. Hunters tell me that they sleep in the latter part of the night and in the heat of the day.

I have seen a nest or bed in the forest where a family of these hogs had slept. It was in a damp place, and was composed of a mass of endogenous plants such as grew there, pulled up by the roots and piled together. Natives say the hogs do not use the same sleeping-place more than one or two nights or days. Even the small pigs follow the sow from place to place, and may be heard squealing as they run after her.

These hogs are fond of dampness and of mud, as are all their kind, and many other animals besides. But they find damp places anywhere in the forest, and are by no means partial to the banks of rivers.

The meat is tender and good, but with little of the characteristic pork flavour.

THE TREE DASSIE (*Dendrohyrax dorsalis*).

This little animal, called "nyôk," utters at intervals during the night a loud, long-drawn, trilling or rattling cry. This is repeated several times in quick succession, with increasing loudness, so that you think the animal nearer when he finishes than when he began. The sound always comes from high up in a large tree. Natives hearing it at night locate it in a certain tree, and go next day and chop the animal out of the hollow high up the tree-trunk, where it lives, and catch it alive. Sometimes two are found together: and they say when the shining of their eyes is seen in the darkness of the hollow tree, one eye only of each animal is seen; if two eyes appear, there must be two animals.

The people all tell me the "nyôk" descends to the ground to feed at night, and that it feeds on the leaves of bushes; a certain

shrub, a species of *Vitex*, has been pointed out as its favourite food. That it eats leaves is certain from what I have seen in the stomachs of specimens. That it goes about on the ground at night is proved by the fact that specimens have been brought to me caught in dead-fall traps on the ground at night. The "nyôk" seems to be silent when on the ground, and utters its cry only when up a tree.

While it is certain that this animal constantly ascends and descends trees, it seems singularly ill-constructed for climbing, and one seeing it would almost as soon expect a pig to have arboreal habits. Its descent is easy, however, if it is true, as the natives tell, that it merely lets go and tumbles down. I have seen, indistinctly, an animal of the size of the "nyôk" tumble from a leaning tree-trunk to the ground and rush off through the undergrowth. Its mode of ascent is difficult to explain: the fact that many trees stand leaning may help to account for it. I have been told more than once that the "nyôk" reaches its high door by means of a ladder of tangled vines such as hang from every large tree, sticking its feet through the loops to climb. The long projecting front teeth look as though they might help it to climb. But a young specimen, the tusks of which did not project at all, was said by the man who brought it to have been shot while climbing a vine. The rubber-like surfaces of its long soles may help it to keep from slipping while climbing.

This animal seems to be a favourite prey of the Leopard and of the Crowned Hawk-Eagle.

The Elephant (*Elephas africanus*).

In this forest country Elephants are seldom seen. Their paths are in the most remote parts of the forest, but they often come on moonlight nights to outlying gardens or to deserted village sites where a few plantains and bananas are still growing. These they tear open, eating the tender heart. When they are feeding the noise of the breaking of branches can be heard to a considerable distance. The only sight I have obtained of elephants wild was at early dawn, in an abandoned garden, which they were just leaving for the forest. I was then struck by the ease with which one bounded over a large log. Many things go to show that elephants wild are far from clumsy, and are even agile in their movements. Their tracks often lead up or down steep hills. They range far through the forest and travel far in a day.

The natives hang a small log, with a large iron spear-head set in the lower end, over a place where an elephant is likely to pass, in such a way that in passing he throws a trigger connected with the vine by which the log is suspended, and lets it drop on his back. When an elephant has been wounded in this way it is tracked far through the forest, sometimes for several days, and occasionally it is at last found dead. With the inferior guns the natives possess, they wisely refrain from shooting elephants, even

when they come upon them. But some men I found in the region of the Ja bold enough to shoot darts headed with broad and sharp chisel-like blades from their guns, and thus kill elephants. When a native kills an elephant he secures a great prize, for a pair of good-sized tusks are a small fortune to him, and the supply of meat is enough for many villages.

At a village on the Benito River I saw where the people, a few months before, had constructed a strong fence at the outskirts of their clearing, where a herd of elephants had been coming of nights to feed. Into the enclosure thus made they had managed to get the elephants, and had killed six or eight of them, shooting them from behind the stockade or from stations in large trees.

Natives sometimes find elephants dead. These may sometimes be such as have been wounded by spears of the kind described above; but I think that they are those that have died a natural death.

A large elephant-skull that I once saw lying by a path in the forest had no sockets for the tusks, but only rudimentary holes the size of one's finger. The people say elephants are often destitute of tusks.

The Species of Anomalurus.

The *Anomaluri*, which have in Fang and Bulu the generic name "ñgui," are among the most strictly arboreal animals that exist. I never saw one, or heard of one having been seen, on the ground; and I know that when one falls to the ground wounded, it is helpless, and does not try to run away. They can ascend and descend large smooth tree-trunks or the inside of hollow trees, where an ordinary squirrel could not go. In such places they have a humping mode of progress like that of a Geometer caterpillar, and the sharp-pointed scales on the underside of the tail are pressed against the tree to aid them. They must be much aided also by the wonderful sharpness and strong curve of their claws. The claws of dead specimens were continually catching on things—on other specimens, the side of the vessel, or even my hand when handling them—and holding so that they were not easily shaken off. I have never seen these Flying-Squirrels on the small outer branches of trees; but they must go on the outer branches, for they leap or sail through the air from one tree to another.

I have often asked the natives what these animals eat. The answers showed ignorance: it was commonly said that they eat fruit or nuts; I was also told that the "avemba ñgui" (*A. beecrofti*) eats "the flesh" of trees, that is, the soft *cambium*-layer under the bark. A greenish pulpy mass I have seen in the stomachs of some specimens seemed to confirm this.

The species just referred to is generally found in the daytime clinging to the inside of large hollow trees, though sometimes, especially towards evening, it is seen crouching against the outside of

the trunks of trees. The "ôwôs ñgui" (*A. beldeni*) is not found in hollow trees—at least, not usually. It is found even in the daytime, crouching flat against the trunks of trees, but is oftenest seen towards evening. The rare *A. fulgens* seems to be like *A. beldeni* in habits. The small *A. batesi*, which seems also to be rather rare, has been found in hollow trees, like *A. beecrofti*.

I have more than once heard a low noise in the forest at night, between a whistle and a hoot, or like the sound of a switch rushing through the air. It was like that made by an owl, though I know of no owl's cry of one syllable as this is. This noise the natives believe to be made by the "avemba ñgui" (*A. beecrofti*).

The Smaller Anomaluridæ.

The two species of *Idiurus*, the rare *Zenkerella*, and the Dormouse are all called by the same Bulu name "ôsi'i-ndan." None of these, except the Dormouse, has ever been found, so far as I know, in any other place than hollow trees. As they seem to spend the daytime in hiding, they must feed abroad at night. Whenever a hollow tree is chopped down, some of these little animals, together with bats, especially the "angoñ" (*Hipposideros cyclops*) and certain species of Muridæ, are found in it. Often boys insert burning plantain-leaves into an opening in a hollow tree near the ground, and the smoke ascending suffocates the little creatures above, so that they drop down and are caught.

The Squirrels.

Several of the species of Squirrel are quite abundant. The commonest of all is the small striped one called "ôsen," or rather the two called "ôsen." This name is applied both to *Sciurus isabella* and *S. lemniscatus*, and as these are very much alike, and I have not usually distinguished them, they must be spoken of together. The "ôsen" is found both in the forest and in the bushes of old clearings. Nests of the "ôsen" are often found, of dry leaves and fibres woven into a complete globe. One I once found, with two young ones in it, had no opening apparent, and the little mother seemed to have closed it after her when she left. These young ones were found in February, and in the same month I was shown other young "ôsen" by boys who had found them.

About nests of the other Squirrels I can say nothing. But I have seen an "ôvaé" (*Sciurus rufobrachiatus*) carrying a spray of green leaves in its mouth as it ran along the branches.

The two large Squirrels (*S. nordhoffi* and *S. wilsoni*) are much alike, though always distinguishable, if seen plainly. The former (called "mvôk") is the commoner; the other (called "nsem") is said to descend to the ground, which the "mvôk" seldom or never does. These two are said by the natives to be able to gnaw through the flinty shell of the "ngali" nut, the hardest vegetable substance I have ever seen; while other Squirrels are said to be unable to do this.

The "édôn" (*S. pyrrhopus*) is often seen running on the ground or on logs. The same native name is applied to the less common *S. auriculatus*. *S. mystax*, which is a third species closely resembling the last two, was common along the banks of the Benito River, in the *Pandanus* bushes growing by the water's edge. It is absent or rare in the Bulu country, where there are no large rivers and no *Pandanus*.

Some of the Squirrels, at least, are able to pass, like monkeys, from one tree to another, by jumping across and catching themselves in the foliage. An "ôvaé" was seen to spring from a limb where it was running, outward and downward, 6 or 8 feet, into the thick foliage of another tree, and catch itself on the leaves and small twigs. An "ôsen" was seen to do the same, but not jumping so far.

I have learned to distinguish the commonest kinds by their chatter. The little "sep" (*S. poensis*) makes a sibilant noise of one syllable, which may be written "pish!" The "ôsen's" chatter is that most often heard, and varies a good deal. The natives represent it by the word "kéngé," which does very well, only that often a syllable is rapidly repeated many times, somewhat as a person who stutters would do in saying "kéngé." The "édôn" separates the syllables more, uttering only one or two together, thus: "ka-paka." The noise the "ôvaé" makes is peculiar and unlike a squirrel, being guttural. The "mvôk" makes a noise with somewhat of the same guttural tone, though less so than the "ôvaé," and with the syllables more separated and the voice stronger and gruffer.

All the commoner kinds of Squirrels have been seen joining in companies with little birds in the forest. It is the habit of many kinds of little birds to feed thus in companies scattered over several neighbouring trees, moving loosely together, and such companies very often have a Squirrel or two in them.

The Muridæ.

The majority of the little animals of the Rat and Mouse family are inhabitants of gardens and the neighbourhood of villages. This is the case with all those belonging to the genus *Mus*; these are all trapped by boys, with various devices, in and around cassava-gardens.

The "mven" (*Mus univittatus*) is reputed to be the most destructive of all to cassava-roots. It is the animal proverbial for greediness, as the pig is among us. It lives and breeds in burrows. It is bolder, and oftener seen running around in the daytime, than the others.

The "ndan" (*Mus tullbergi*) lives in hollow logs and such places. It often comes into houses to find food and to nest, and becomes a house-mouse.

The "abok" (*Ænomys hypoxanthus*) lives in the bushes growing on waste ground immediately around villages. It makes nests of

dry grass in bushes, 4 or 5 feet from the ground. When meat is scarce, the village boys often hunt "mebok" for food. They generally hunt them at dusk, when they (the rats) begin to stir abroad, killing them with sticks or with bow and arrow, or surrounding them in the weeds and driving them into a net, or under an old cloth or piece of bark. This hunting "mebok" is a great sport with the village boys. Owls often come around villages at dusk, probably for the same purpose.

The tiny *Dendromus messorius* likewise makes a nest in the weeds and grass around villages; its nests are nearer the ground than those of the "abok."

The pretty little striped *Arvicanthis pulchellus* also lives in the weeds and grass around villages, often coming right into the village street, when that is weedy. It is not found within 60 or 70 miles of the coast, where the village clearings are smaller and more scattered than they are farther inland. The people call it "ze-fô," or leopard-mouse, from its bright colour. There is a proverb to the effect that "you do not need to tell the leopard-mouse where to turn off the path."

The little red *Lophuromys sikapusi* is another inhabitant of the bushes and grass that grow only about villages. It is a curious fact that most of the examples of this species caught have stumpy tails or no tails at all. The notion of the people about it is, that whenever the "ékui" (as they call this mouse) crosses a path it loses its tail.

The "nsomian" (*Deomys ferrugineus*) is trapped, as the others thus far mentioned are, in old cleared land about villages; but it seems to live also in the forest. I have seen one caught by smoking it out of a hollow tree.

The "ndôn" (*Malacomys longipes*) is an inhabitant of the forest, where it is often caught in dead-fall traps set for the large rodent "kôé."

The "kôé" (*Cricetomys gambianus*) lives in burrows in the forest. Trapping it is considered a pursuit worthy of men, while other Muridæ are left for boys. Men go on camping-trips far into the forest for this purpose, finding a place where the "kôé" are abundant, and there setting many traps and staying several days, drying the bodies of their catch over the fire, to take back to the village and store for future use. I have heard, when passing along a forest-path at dusk, a little piping or squeaking noise that my guide said was made by the "kôé."

The Black Rat has been introduced, and has established itself in the villages at and near the coast. It has not yet got more than fifty miles inland.

The Brush-tailed Porcupine (*Atherura africana*).

Porcupines hide in rocky places, under and between the rocks, and in hollow logs. They are found in such places in the daytime, and are said to walk abroad only at night. They are hunted

with dogs, the small native dogs entering their holes and driving them out. Often the dogs themselves catch and kill the Porcupine, seizing it by the throat, where there are no quills. If it escapes the dogs, it is driven by men, with much hallooing, to a place where a net is stretched, into which it runs and is caught. Often several are caught at once in this way.

THE PANGOLINS (*Manis*).

The one or two small species of *Manis* are called "ka," and the large one, which I have heard of but not seen, and suppose to be *Manis gigantea*, is called "avi."

They all burrow in the earth. The "ka" must be mainly nocturnal. One brought to me was said to have been caught walking on the ground in the forest at early morning. Another was found in the daytime on top of one of the ants' nests, like huge hornets' nests, that are found adhering to the trunks of trees. Those I have received as specimens have generally been brought alive and curled up tightly. It takes much strength to unroll them, and they are hard to kill. When forcibly unrolled they eject in small quantities a very pungent yellow liquid; some of this that fell on a porch at the Benito mission-station permanently discoloured the paint.

4. A Contribution to the Study of the Function of the Antennæ in Insects. By MACLEOD YEARSLEY, F.R.C.S., F.Z.S.

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The true function of the antennæ of insects has for many years been a disputed point. As early as 1838 Lefebvre (**1**) disagreed with Oken, who regarded them as auditory organs, and attributed to them the olfactory sense. In 1847 Erichson (**2**), by reason of his anatomical studies of the antennæ, adhered to this view. The subject was also investigated by Leydig (**3**) in 1855, who traced the antennal nerve to the organs discovered by Erichson. He also (**4**) described what he considered to be auditory end-organs. Lowne (**5**) pointed out that one anatomical fact (first noted by Diette (**6**) in 1876), viz., the similarity of structure between the antennal ganglion and the olfactory bulb of vertebrates was in itself a guide to the function of the antennæ; and Perris (**7**) made systematic investigations by experiments on living insects and established their olfactory function. It would, however, be fruitless to attempt to mention all who have expressed opinions—supported by more or less evidence—upon the subject. Indeed, Kraepelin gives references to more than 100 papers dealing with the question between 1730 and 1883. Certain observations have been made by Kirby (**8**), Meyer, Lehmann (**9**), Leydig, Gruber, Hurst (**10**), Hammond, and others

in favour of an auditory function; but a perusal of their investigations does not convince. A more favourable verdict can be accorded to the conclusions of Perris (**11**), Hausa (**12**), Forel (**13**), and Plateau (**14**) in support of an olfactory function.

Lowne (**15**), in discussing the whole matter, thought it improbable that the antennæ contain organs of audition in insects, and remarks: "I think it more probably a balancing organ than an auditory organ in the strict sense of the word."

Lord Avebury (**16**) describes an individual ant (*Myrmica ruginodis*) which had lost the terminal portion of both her antennæ: "She seemed to have lost her wits. I put her into a nest, but the others took no notice of her; after wandering about a little, she retired into a solitary place, where she remained from 3 P.M. to 8 P.M. without moving. The following morning I looked for her at 5.30, and found her still at the same spot. She remained there till 9, when she came out. She remained out all day; and the following morning I found her dead."

Latreille (**17**), quoted by Lord Avebury, says: "Le sens de l'odorat se manifestant d'une manière aussi sensible, je voulois profiter de cette remarque pour eu découvrir le siège. On a soupçonné depuis longtemps qu'il résidoit dans les antennes. Je les arrachai à plusieurs fourmis fauves ouvrières, auprès du nid desquelles je me trouvois. Je vis aussitôt ces petits animaux que j'avois ainsi mutilés tomber dans un état d'ivresse ou une espèce de folie. Ils erroient çá et là, et ne reconnoissoient plus leur chemin. Ils m'occupoient; mais je n'étais pas le seul. Quelques autres fourmis s'approchèrent de ces pauvres affligées, portèrent leur langue sur les blessures, et y laissèrent tomber une goutte de liqueur. Cet acte de sensibilité se renouvela plusieurs fois; je l'observai avec une loupe."

The "condition of intoxication or species of madness" exhibited by Latreille's ants, bereft of their antennæ, is at least suggestive of support to Lowne's surmise; moreover, the results of experiments carried out by Yves Delage (**18**) upon Cephalopoda and Crustacea and by Clemens (**19**) upon *Samia cecropia* support it yet more strongly.

With a view of obtaining further evidence upon the matter, I recently (1904) made a series of experiments upon Wasps. I captured at different times a number of specimens (30 in all) of *Vespa vulgaris*, and subjected them to removal of their antennæ. My method was to confine each wasp under a small inverted wineglass, beneath which was placed a little powdered sugar. By cautiously introducing a pair of fine angular scissors under the tilted edge of the glass, I was able to snip off each antenna at its base. The insect thus mutilated was then carried into the garden and its movements carefully watched.

Experiments thus made on 30 wasps gave uniform results. On first losing its antennæ, each wasp kept passing its front legs between its jaws and then rapidly drawing them over the tiny wounds left by the scissors. Each wasp continued this manœuvre

for from 5 to 10 minutes, after which it ceased to pay attention to its injury and tried to fly. Attempts at flight generally occupied another 5 minutes, and were invariably attended with the same result. Each time the wings were opened, the insect was raised for about an inch from the ground and then turned a somersault headforemost, like an acrobat. These somersaults were always headforemost, the animal alighting on its back and struggling to its feet again.

Each wasp made some score or more attempts at flight, always with the same result. They then desisted and wandered slowly about as if uncertain of their bearings, blundering up against obstacles. Several were placed upon a window-sill, and each one so placed, if it reached the edge in the course of its wanderings, immediately fell off.

Summarised, the results of the removal of the antennæ in the 30 wasps were :—

1. Loss of the power of flight.
2. Loss of the sense of direction.
3. Very noticeable slowness in all movements.

It has been suggested to me that the loss of flight and the somersaults made headforemost every time that flight was attempted might have been due to the loss of a balancing weight occasioned by the removal of the antennæ, and that the experiment should be made of fixing on false antennæ in order to ascertain whether the insect would thus regain its power of flight. Whilst admitting that this explanation is possible, I would point out that, if the want of balance were due to the absence of the anterior weight of the antennæ, the insect would be more likely to turn over backwards, on account of the over-balancing weight of the abdomen, whereas the wasps experimented upon invariably turned over headforemost.

The conclusion to be drawn from these experiments is that, in wasps, the antennæ are equilibrating in function, and in this respect they agree with Lowne's surmise, quoted above, and with the experiments of Clemens on *Samia cecropia*, already cited.

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16. 'Ants, Bees, and Wasps,' p. 96.
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18. Arch. de Zool. 2e séries, tom. v. 1887.
19. Journal of the Acad. of Nat. Sciences, Philadelphia, vol. iv. pp. 158–160.

5. Notes on a small Collection of Heterocera from the Fiji Islands, with Descriptions of some New Species. By G. T. Bethune-Baker, F.L.S., F.Z.S.

[Received November 29, 1904.]

(Plates VIII. & IX.*)

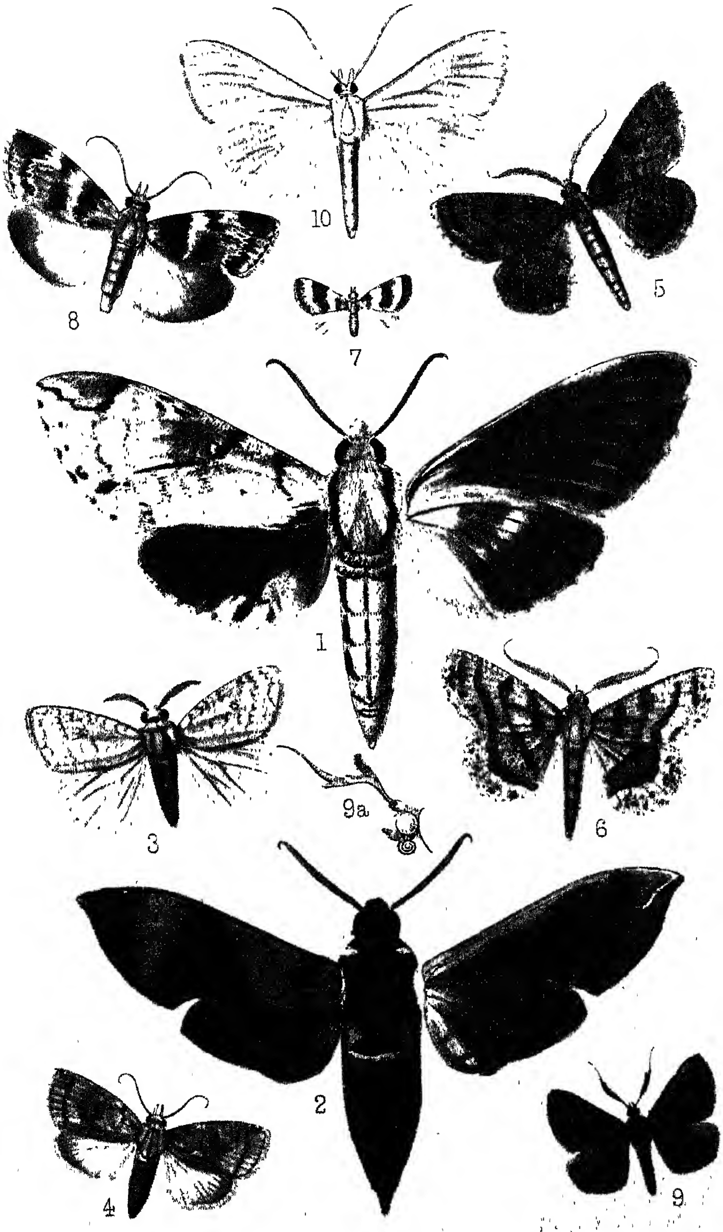
In the early part of last year I received, through the kindness of my friend Mr. Waterhouse of Sydney, a small collection of Heterocera from the island of Viti Levu (the largest of the Fiji group), among which are several interesting new species and some new records. The measurements of the specimens are taken by measuring the length of the wing from the centre of the thorax to the apex of the primary and doubling it. All the insects were taken at Nausori on the Rewa River.

Sphingidæ.

Psilogramma jordana, sp. nov. (Plate VIII. fig. 1.)

♂. Head and thorax pale grey; patagia edged laterally with black, below which is a whitish stripe, the black stripe is continued through the metathorax and meets in the centre. Abdomen grey with a dark central dorsal stripe, a broad lateral rust-red patch on each side which merges into the dark lateral wedge-shaped spots of the posterior segments. Palpi grey, with a broad lateral dark rust-coloured stripe below the tip. Primaries whitish, basal

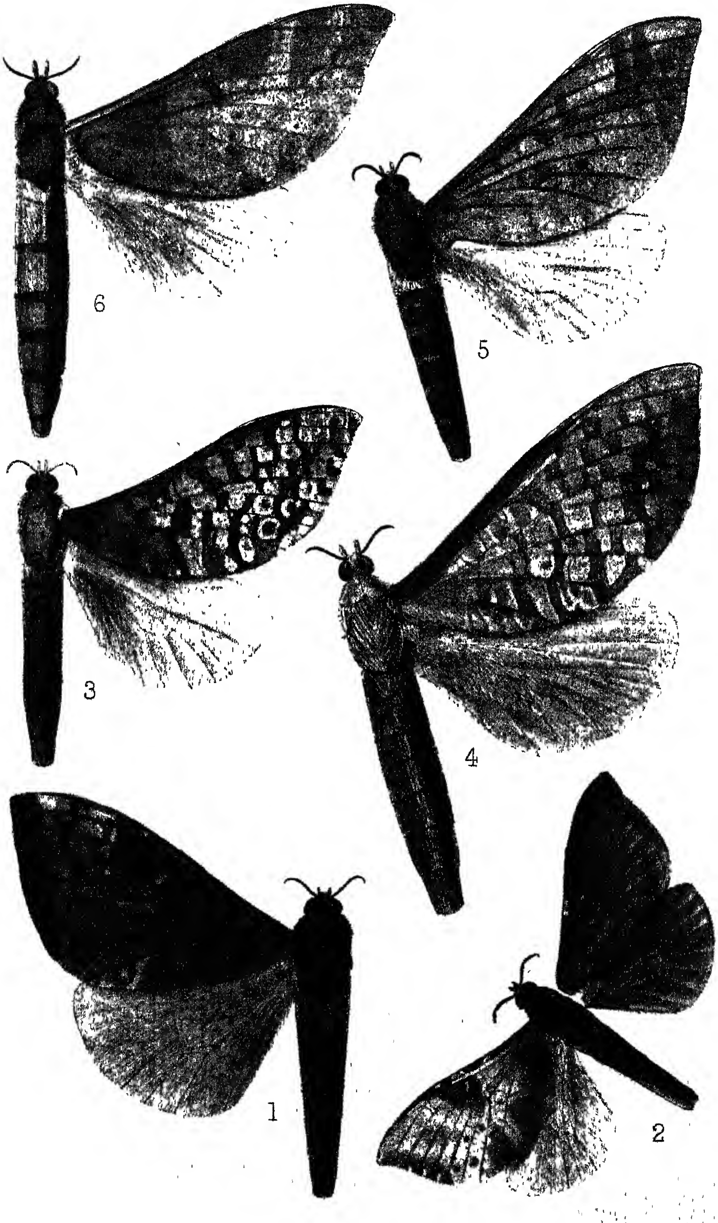
* For explanation of the Plates, see p. 95.



E.C.Knight del.et lith.

West, Newman imp.

HETEROCERA FROM THE FIJI ISLANDS



E.C.Knight del et lith. West, Newman imp.

area suffused with grey, with a dark spot on the costa at the base and another at a fifth, a small rust-red patch at the base of the inner margin; a medial large grey patch to vein 2 and bounded on the costa by two short blackish stripes, the one nearer the base touching a whitish spot near the end of the cell and encircling it, a double postmedial strongly serrated line terminates this medial patch; a subterminal deeply arched interrupted blackish dentate line rising in a heavy black costal dash, beyond which is a wedge-shaped dark grey patch with a white outer margin; from the apex a dentate black oblique stripe meets the costal dash; between veins 3 and 5 are three dark marginal patches, the uppermost one obsolescent; cilia white, broadly intersected with rust-colour; between veins 3 and 4 a black, slightly curved stripe from the cell to the subterminal line; there is a slight grey scaling beyond the basal grey area; secondaries rich deep rust-colour, with a broad obscure black termen interrupted by the ground-colour at the veins, three pale lavender-greyish patches in the tornal area. Under surface: both wings rusty reddish, primaries with a broadish postmedial line, secondaries with a broad medial and postmedial line.

Expanse 106–110 mm.

The type from Nausori is in my collection.

Chromis erotus (Cram.).

My specimens are somewhat different from ordinary specimens from Australia and New Guinea &c., the brown oblique nebulous stripes in the primaries are absent, giving them an unusual appearance; there is, however, a trace of the stripe in one specimen.

Hepialidæ.

Phassodes, gen. nov.

Palpi porrect, end segment depressed slightly; antennæ short, filiform; all the legs fringed with hair on each side, hind legs with the tarsus perfect; tibiæ and femora short. Neuration as in the genus *Phassus* Wlk., but with two bars close together from near the base of vein 12 to the costa in the primaries; vein 1*a* free, 1*c* of moderate length, a bar from 1*b* to 1*c* and to the median vein; veins 9 and 10 in both wings forming a long fork on a long stalk. Primaries more or less excavated in both sexes below the apex, and decidedly longer than the secondaries; near the base of the inner margin of the primaries in the ♂ is a large gland (evidently a scent-gland), with a semicircular opening towards the cell.

Type, *Phassodes odorevalvula* B.-B.

In section B the neuration and other characters are precisely the same except that the scent-valve is absent. I am strongly of opinion, however, that a genus should not be created on a purely sexual character.

All the species are strongly scented.

Section A.

PHASSODES ODOREVALVULA, sp. nov. (Plate IX. figs. 1, 2.)

♂. Head and thorax brownish grey, abdomen paler. Primaries pale grey, almost entirely suffused with darker grey and closely covered with spots not quite so dark; a large scent-valve occupies the basal area of the inner margin, with a crescentic opening towards the costa, two parallel marks on the valve, a series of antemedial spots, a medial series from the costa to vein 4; a silver spot at the upper angle of the cell proper and also in the angle of vein 6, beyond which is the postmedial series of spots from the costa to just in front of the tornus, followed closely by a very irregular series to vein 3, the subterminal row somewhat confluent with the terminal row; a pale spot on the costa above the silver spot, and two pale patches in front of apex. Secondaries uniform pale ochreous, tornus darkish grey.

Expanse 70–102 mm.

The type is in my collection from Nausori. I have also a much smaller specimen from the same locality, in which the spots are somewhat obsolescent and obliterated, the patches on the costa are paler and contrast strongly with the darker areas, whilst there is a broad pale patch on the inner margin in front of the tornus. There is no doubt, however, that they are both the same species.

Section B.

PHASSODES GUTHREI, sp. nov. (Plate IX. fig. 3.)

♂. Head, thorax, and legs pale reddish, abdomen darker. Primaries greyish, covered nearly all over with ochreous-reddish spots; base entirely so covered for a fifth; a narrow irregular silvery white streak across the cell to vein 2, followed by the confluent spots across the cell, with a silvery wedge-shaped patch below, touching which is a long subovate spot to beyond the middle of the inner margin; a silvery patch in the upper part of the cell, enclosing two small confluent spots (the lower of which is shifted outwards) except as to their lower margin, following which are three large confluent spots, the lower of which touches the subovate spot; a silvery patch margins the upper spot and is followed by two pairs of confluent spots, divided by another silvery patch, below which is a long spot in the angle of veins 5 and 6, with an irregular series of four roundish spots below it to the tornus; above the two pairs of spots is a small one margined laterally with silvery, with a larger spot beyond and two smaller below it; a postmedial series of eight irregular spots from vein 8, above which to the costa is a short twin series of three spots, the lowest spot being the largest; a subterminal series of spots, those near the tornus being darkly pupilled; termen spotted with fair-sized spots separated by silvery patches; a large silvery twin patch margins internally the subterminal spots between veins 5 and 7. Secondaries uniform creamy ochreous.

♀. Entirely brownish grey with paler spots darkly-pupilled.

Expanse, ♂ 100–105, ♀ about 120 mm.

The types are in my collection and were taken near the Rewa River in Viti Levu.

PHASSODES BIMORPHA, sp. nov.

♂. Head, thorax, and abdomen brown. Primaries darkish brown, with the spots obsolescent; a darkly-pupilled obscure spot outside the cell in the angle of veins 3 and 4, and two spots equally obscure near the termen between veins 4, 5, and 6; two slightly paler patches on the costa towards the apex. Secondaries pale ochreous.

Expanse 114 mm.

The type from the Rewa River, Viti Levu, is in my collection.

I have a second smaller specimen which may be of the same species, from the same locality, but it is very much paler, and the spots are more distinct, but the three darkly-pupilled spots are present as in the type.

More material may prove this species to be a dark form of the preceding one, but it is so different in colour and general appearance that we must treat it as distinct until proved to the contrary.

PHASSODES NAUSORI, sp. nov. (Plate IX. fig. 4.)

♂. Head and thorax pale brownish grey, abdomen pale ochreous grey. Primaries pale grey, almost entirely covered with spots and patches of the same colour, finely and darkly margined, and separated by metallic silver markings, which are more pronounced and larger in the posterior third of the wing. In the upper part of the cell are three of these silver dividing lines which are fine; at the upper angle of the cell there is a silver spot, followed by a double mark like the letter H without the central bar; above and below this is another; there is a very interrupted and broken posterior line of these silver marks, and a double, less irregular subterminal line, and also a terminal row. Secondaries ochreous grey.

Expanse 119-125 mm.

The type from Nausori on the Rewa River (Viti Levu) is in my collection; and I have a second specimen which I believe to be this species, also a male, but which has no trace whatever of the silvery markings.

PHASSODES REWAENSIS, sp. nov. (Plate IX. fig. 5.)

♂. Head, thorax, and abdomen dusty grey. Primaries pale grey, with the basal area covered with crowded spots barely paler than the ground-colour; an irregular medial series of three large spots; a double postmedial series of spots, the outer series slightly smaller than the inner, in the latter the spot between veins 3 and 4 is darkly pupilled; a short row of three or four spots from the costa to vein 6; a double subterminal row, the inner of which extends only to vein 4, and the spots are small and isolated. Termen

spotted; the upper part of the cell is closed by a silver spot darkly margined, from which a dark line runs along vein 6 to a smaller silver spot in the postmedial outer series. Secondaries ochreous grey, slightly darker beyond the cell.

Expanse 110 mm.

The type from Nausori is in my collection.

PHASSODES VITENSIS, sp. nov. (Plate IX. fig. 6.)

♂. Head, thorax, and fore legs orange-brown, abdomen brownish. Primaries orange-yellow, with the spots very obsolescent, except a sharply defined silver spot closing the upper part of the cell and an irregular ill-defined silvery dash from vein 6 to below the apex; beyond the first of these is a very obscure curved row of spots on each side of which the ground is slightly paler; in front of the silvery dash is another obscure row, the spots over the wing being almost the same colour as the wing. Secondaries pale ochreous.

Expanse 114 mm.

The type from Nausori is in my collection.

THYRIDIDÆ.

RHODONEURA MYRTÆA Drury.

One specimen in which there are four hyaline spots in the primaries, the uppermost and the two lowest being quite small.

LYMANTRIIDÆ.

DASYCHIRA VITENSIS, sp. nov. (Plate VIII. fig. 3.)

♂. Head, thorax, and legs whitish grey; abdomen probably the same colour or a little darker, but only a portion of the abdomen remains. Antennæ with white shafts and reddish-brown cilia. Primaries greyish white, with basal and subbasal lines indicated only by two costal dots and one or two obscure marks in the cell; antemedial line very fine, serrate, pale reddish brown, rising in a dark grey costal spot; medial line fine, obscure, second medial line double for its upper portion, serrate, inwardly oblique, fine and paler for the lower half; postmedial line irregular, serrate, curved, fine, pale brown; subterminal line dark, irregular, interrupted at the veins; fringes white. Secondaries very pale brownish white, darker in the subapical area; fringes white.

Expanse 44 mm.

The type from Nausori is in my collection.

ARCTIIDÆ.

DEILEMERA FASCIATA.

I received a single specimen of this insect.

ŒONISTIS ENTELLA Cram.

One specimen of Cramer's species which is quite typical, and not *delia* Fab.

UTETHEISA PULCHELLA L.

One specimen in which the red stripes are almost obsolete.

NOCTUIDÆ.

ARCILASISA PLAGIATA Wlk.

One specimen of this very variable insect.

STICTOPTERA DESCRIBENS Wlk.

This is, I believe, a new locality for this species.

ARGYROTHRIPA NIGROSTRIGATA, sp. nov. (Plate VIII. fig. 4.)

Head and thorax whitish grey, abdomen darker grey. Primaries pale grey, with a slightly darker basal patch on the costa having a prominent black edging all round except on the costa; medial and postmedial lines very irregular and dentate, almost parallel, the area between being slightly darker in colour; subterminal line prominent, black, slightly excurved, a small apical black spot; termen finely dotted with black. Secondaries whitish sub-hyaline, with the costa and termen grey, the latter tapering rapidly towards the tornus.

Expanse 34 mm.

The type is in my collection from the Kebea Range, British New Guinea, where it flies in July at an altitude of 3600 ft. In the National Collection, however, is a single specimen from Fiji, which is almost identical with the New Guinea specimens, the only difference being that it is slightly paler.

HYPÆNA MASURIALIS Guen.

One specimen of the form *ferriscitalis* Wlk.

GEOMETRIDÆ.

ALCIS VITENSIS, sp. nov. (Plate VIII. fig. 5.)

♂. Head and thorax ochreous brown; abdomen grey, scaled with ochreous brown. Both wings warm ochreous brown. Primaries with basal line blackish, irregular, outwardly produced in the centre; median line angled at the cell, then receding slightly basewards and slightly interrupted; postmedial line fine, black, dentate, angled outwards at veins 6 and 7, then receding rapidly basewards; a trace of a subterminal pale line which is interrupted and irregular; termen finely darkly-dotted. Secondaries with median dark line from upper margin of cell slightly curved; a darkish indefinite small cell-spot pupilled with whitish; postmedial line blackish, crenulate, with a slight outward curve in the median area; subterminal pale line more distinct than in the primaries, with indefinite dark spots on its inner margin. Abdominal fold whitish. Both wings are somewhat irrorated with fine blackish scales. Under surface of primaries dark brown, with blackish cell-spots, on each side of which is a pale patch and another small pale patch at

the apex. Secondaries with the basal half of the wings pale, with a blackish cell-spot; outer half dark greyish brown, with a pale patch on the inner margin above the tornus.

Expanse 46 mm.

The type from Nausori is in my collection. I have one specimen which is uniformly paler, but otherwise not different from the type. The species is nearest *tongaica* Btl., but the lines differ in shape and are single, not double, the wings are broader, and the colour quite different.

ALCIS NAUSORI, sp. nov. (Plate VIII. fig. 6.)

♂. Head and thorax pale ochreous grey, abdomen paler; legs pale grey, scaled with darker lilac-grey; fore tarsi blackish, palely ringed. Both wings pale ochreous grey, finely and sparingly irrorated with grey. Primaries with a broad oblique basal band of lilac-grey; a trace of a median line and a broad curved postmedial line, a trace of a subterminal line; a short terminal blackish dash on vein 5, with two shorter ones above it, at the same spot is an indefinite lilac-grey small terminal spot; termen darkly dotted. Secondaries with an oblique dark line just before the whitish cell-spot; postmedial line angled about vein 5, then receding basewards in a slight curve, the area between these two lines being filled in with lilac-grey; termen strongly crenulate, darkly dotted in the vein interspaces. The whitish cell-spot in both wings is finely edged with blackish.

Expanse 46 mm.

The type from Nausori is in my collection.

LARENTIA REWAENSIS, sp. nov. (Plate VIII. fig. 7.)

Primaries pale brownish ochreous, with the base and postmedial area dark brownish, the latter being somewhat wedge-shaped in form, broad on the costa and narrow on the inner margin, both are finely edged with white; subterminal line narrow, brown, from which to the termen the colour is pale brownish. Secondaries uniform pale grey.

Expanse 18 mm.

The type is in my collection from Nausori; the sex is uncertain as the abdomen is partly broken off, and the antennæ are also missing.

ANISODES PORPHYROPIS Mey.

This species is represented by a single specimen.

THALASSODES VERARIA Guen.

One specimen only.

PYRALIDÆ.

LOCASTRA DRUCEI, sp. nov. (Plate VIII. fig. 8.)

♀. Head chestnut-brown, with frons darker; thorax pale chestnut-brown finely irrorated with darker chestnut-brown;

abdomen pale greyish ochreous-brown; legs chestnut-brown banded with black, with blackish tarsi palely ringed. Primaries reddish brown, finely scaled more or less all over with black; base pale with a trace of a pale basal dentate line; a darker wedge-shaped costal patch edged by a white stripe right across the wing, rising in an indefinite costal patch, beyond which is a black spot at the end of the cell, the median area below it being pale and only slightly scaled with black; postmedial line white (rising in a whitish costal patch), strongly serrate and curved outwardly; terminal area greyish; termen darkly dotted in the nerve interspaces. Secondaries with the basal half of the wings pale greyish; costa and terminal half dark brownish, with a W-shaped mark on veins 2 and 3. Fringes pale, darker near the termen.

Expanse 46 mm.

The type from Nausori is in my collection.

DICHOCROSIS sect. DADESSA FLUMINALIS Btl.

One quite typical specimen.

GLYPHODES CÆSALIS Wlk.

GLYPHODES PSITTACALIS Hb.

Neither of these two species appears to have been recorded from Fiji before.

STREPSIMELA PSEUDADELPHA Mey.

Three specimens.

EXPLANATION OF THE PLATES.

PLATE VIII.

Fig. 1. *Psilogramma jordana*, p. 88.
*2. *Deilephila placida-torenia* Druce.
3. *Dasychira vitensis*, p. 92.
4. *Argyrothripa nigrostrigata*, p. 93.
5. *Aleis vitens's*, p. 93.
6. *Aleis nausori*, p. 94.
7. *Larentia rewaensis*, p. 94.
8. *Locustra drucei*, p. 94.
*9. *Eurytorna heterodoxa* Meyr.
*9 *a*. „ „ antenna enlarged.
*10. *Margarona oceanitis* Meyr.

PLATE IX.

Fig. 1. *Phassodes odorevalvula*, ♂, p. 90.
2. „ „ var., ♂.
3. *Phassodes guthrei*, ♂, p. 90.
4. *Phassodes nausori*, ♂, p. 91.
5. *Phassodes rewaensis*, ♂, p. 91.
6. *Phassodes vitensis*, ♂, p. 92.

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* The species marked with an asterisk are not mentioned in the text, but being not well known I have taken this opportunity of figuring them.

6. On some Points in the Anatomy of the Theriodont Reptile *Diademodon*. By R. Broom, M.D., C.M.Z.S., Victoria College, Stellenbosch.

[Received December 29, 1904.]

(Plate X.*)

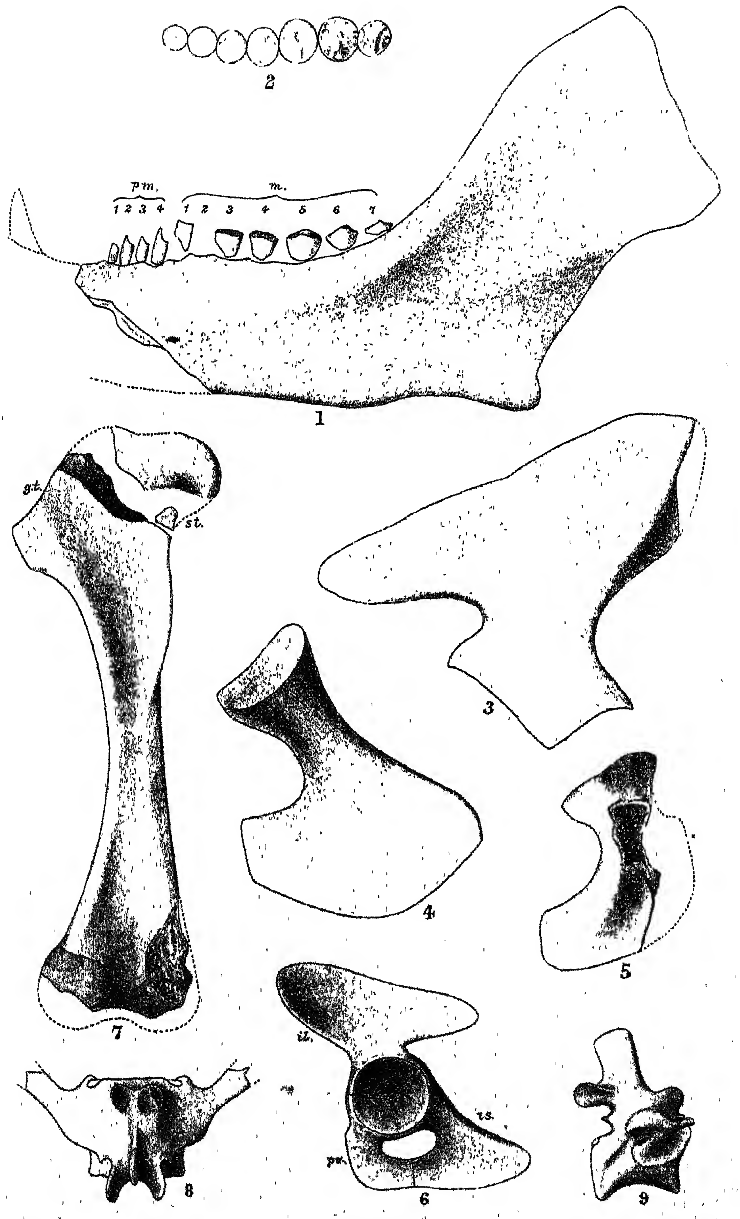
Mr. Alfred Brown, of Aliwal North, to whom science already owes so much, has recently made another discovery of considerable importance. In the neighbourhood of Aliwal he has found a very well-preserved Theriodont mandible with a number of other well-preserved bones, all belonging to the same individual; and these he has kindly forwarded to me for examination and description. When the remains were fully developed it was found that we had two dentaries, two ilia, two ischia, a pubis, a femur, and a lumbar vertebra of *Diademodon mastacus* Seeley. Though the type specimen consists of only a fragment of maxilla with some molar teeth, the molars in the present mandible agree so closely in structure and size as to leave little doubt that the remains are those of *D. mastacus*.

With the exception of the anterior part, both dentaries are well preserved, the hinder part of the left being in almost perfect condition. The symphysis is missing, but from the impression left it is pretty manifest that the two dentaries have been anchylosed in front. The dentary resembles that of *Gomphognathus* and *Trirachodon* in the very great development of its posterior portion. The coronoid process is of large size, but does not terminate in a posteriorly directed point as in most mammals. The posterior part of the dentary, as in *Cynognathus*, probably almost reached the articulation, and apparently overlapped the articular as in the better known Theriodonts. A small but distinct angle is formed, very similar to, but better developed than, that in *Trirachodon*.

Behind the canine there is a short diastema of about 10 mm., and then a series of four teeth which may be regarded as premolars. Behind the premolars are seven molars.

The first premolar is smaller than the others, but is imperfectly preserved. It probably, however, does not differ from the others in structure. Each of the posterior of three premolars is a rounded tooth in which the height is about twice as great as the antero-posterior measurement. When viewed from the outer side, each tooth appears to be a simple pointed cone, but in reality the top is about as broad as the base, owing to there being on the inside of the tooth a second cusp only a little shorter than the outer. The outer cusp in the unworn condition is probably finely serrated on both its anterior and posterior edges. The fourth

* For explanation of the Plate, see p. 102.



R. Broom del.
M.P. Parker lith.

Parker & West imp.

DIADEMODON MASTACUS.

tooth on the right side shows the anterior serrations, and the second tooth on the right side bears indications of the posterior serrations. At the base of the posterior edge of the outer cusp there is seen in three of the teeth what looks like a very small secondary cusp, but this may be merely a ridge which joins the outer and the inner large cusps. It will thus be seen that the premolars have crowns very like those of the human bicusps, but differing in having the cusps more marked and with small serrations at least on the outer side. Each tooth that has been displayed has a single cylindrical root.

All seven molars on the right side, and all except the second on the left, are preserved. The first four are round teeth with flat tops. It is probable that the flattening is largely due to wear, and the enamel seems to have been worn off the tops of at least the first four. In the fifth much of the enamel is worn off, but in the sixth and seventh teeth there is no evidence of wear. In removing the matrix, which is a fine-grained calcareous sandstone, the processes of the enamel were found very apt to adhere to the matrix and to become detached from the dentine, but fortunately almost every feature of the sixth and seventh molars is preserved on either one side or the other.

The sixth molar, when viewed from above, has an almost circular crown, being only very slightly broader transversely than antero-posteriorly. There is a single prominent cusp on the middle of the outer edge, and a second similar but slightly smaller cusp on the middle of the inner edge. Between these two there is a well-developed, slightly concave ridge interrupted in the middle by a slight elevation, and dividing the crown of the tooth into almost equal anterior and posterior portions. The anterior portion, which is moderately flat, slopes down from the median ridge to the anterior edge, which is slightly elevated and supported by three small cusps. These cusps are arranged as follows:—one between the middle of the anterior edge and the large external cusp, but nearer to the middle line; the other two immediately in front of the large internal cusp. The posterior half of the crown is somewhat similar to the anterior, but rather more concave; it has the posterior edge supported by a series of small cusps. On the two sides the arrangement is slightly different: on the right side there are four subequal cusps close together; on the left side one larger cusp takes the place of the centre two.

The seventh molar is considerably smaller than the sixth, but fairly similar in structure. The posterior part of the crown is narrower than the front part. There are two cusps on the anterior edge, and two, with possibly a small third, on the posterior edge.

When the lower molars are compared with the upper molars described by Seeley, it is seen that they fit satisfactorily—the transverse ridge on the lower molars fitting between two upper molars, and the ridge of the upper between two lower molars.

The outer cusp of the lower molar would fit into the hollow on the inner side of the outer cusps of two upper molars.

The molars of *Diademodon* are compared by Seeley with the molars of *Ornithorhynchus*, *Ctenacodon*, *Plagiaulax*, and *Tritylodon*, and by Osborn with the molars of *Microlestes*. Although there is some superficial resemblance between the tuberculated molars of the multituberculate mammals and those of *Diademodon*, it seems to me more probable that there is no close affinity between the teeth, and that those of *Diademodon* have originated in quite a different manner from those of the Multituberculata. The structure of the premolars in *Diademodon* gives us a clue to the way in which the molars have been formed. There we find an outer and an inner cusp, which we may perhaps call the "protocone" and the "deuterocone." In the molar we find evidences of the same two cusps, but instead of being long and sharp they are here obtuse, and by the sides of the molar we have a number of small other cusps. Like the premolars, the molars are single-rooted, and they bear almost the same relations to each other as do the molars and premolars in *Cynognathus*. *Diademodon* and the allied *Gomphognathus* and *Trirachodon* are so closely allied in the structure of the skeleton to *Cynognathus* as to suggest that the forms with broad molars are descended with only slight modifications from carnivorous types. Among mammals we occasionally find flat-crowned teeth in types closely allied to others with sharp teeth—as, *e. g.*, in the Sea-Otter (*Enhydra*) and the Common Otter (*Lutra*), or in the Bear (*Ursus*) and the Dog (*Canis*); and though in *Diademodon* and *Cynognathus* the difference probably is greater in degree, it does not seem to be different in kind.

Gomphognathus and its near allies are regarded by Seeley as herbivorous forms, and I am not aware that this view has been questioned by any later worker. There is something, however, to be said against it. *Gomphognathus*, *Trirachodon*, and *Diademodon* have all powerful canine teeth, and in *Gomphognathus* and *Trirachodon*, at least, these are separated by small incisors. The condyle of the jaw is in a line with the molar teeth. There is a very large coronoid process and the temporal fossa is of large size. These prove conclusively that the forms with flat molars had at least powerful temporal muscles, such as are rarely or never found in herbivorous mammals. We have also evidence that *Gomphognathus* was able to open its jaws very widely, as in the type specimen the mandible is found open at about 90° without much dislocation of the joint. When we look at the teeth we find that they do not seem suited for a vegetable diet. The second last molar in the above-mentioned specimen of *Diademodon* must have been for a considerable time in use, but the enamel has not yet begun to wear off; and as the layer of enamel is not thicker than a sheet of notepaper, it will be manifest that whatever it was used to crush it is not likely to have been vegetable fibre. It seems to me probable that *Diademodon* and *Gomphognathus* fed

largely on carrion—possibly the carcases of the large Dicynodons that had been killed by Cynognathi.

It seems to me unnecessary to discuss the supposed relationships between *Diademodon* and *Tritylodon*, as I have recently elsewhere endeavoured to show that *Tritylodon* is, as believed by Owen, Lydekker, Cope, and others, a true Mammal, and probably not at all nearly related to the Theriodonts.

The following are the principal measurements of the jaw and teeth :—

	millim.
Length from tip of coronoid process to angle ...	61
Depth of jaw at m 6	22
Depth of jaw at m 3	20
Length of seven molars	35
Width of m 6	6·7
Length of m 6	6

Both ilia are well preserved, but unfortunately only the inner sides of each are displayed, and owing to the softness of the bone it does not seem advisable to remove the matrix from the outer side of either. The most striking character of the ilium is the great antero-posterior development of the crest. From the constricted part above the acetabulum the ilium extends upwards and forwards to end in a rounded anterior expansion, and also extends backwards to form a sharp posterior portion. The anterior part has its anterior edge turned considerably outwards, so that a deep concavity is apparently formed on the front part of the outer side of the iliac expansion. Below the constriction the ilium expands again to form the upper part of the large acetabulum. In *Cynognathus* the anterior part of the ilium is missing, but the parts preserved are very like those of *Diademodon*, and it is thus probable that Seeley's restoration of the anterior part is too small.

The most important difference between the Mammalian ilium and that of the Theriodont is that, owing to the pelvis in the mammal lying more antero-posteriorly, the anterior part of the ilium is itself sufficient for the attachment of the sacrum, and hence the posterior part becomes usually greatly reduced or lost completely. In *Orycteropus* the posterior part of the ilium is unusually well developed, and not unlike the Theriodont condition, but in most Marsupials it is practically absent. In the Monotremes and in the Wombat there is a small but distinct posterior portion.

The pubis is a little imperfect, as a portion of the anterior part is missing. In general structure it is very mammal-like. Immediately below the acetabular portion, the bone is somewhat constricted, and at this point there passes inwards and forwards a plate which is probably of a similar nature to the anterior part of the pubis in *Cynognathus*; but in *Diademodon* it seems to be directed more inwards than in *Cynognathus*. Whether it is a

pectineal process entirely, or a process for the attachment of a cartilaginous prepubis, the evidence does not show. The symphysial portion is typically mammalian.

The ischium is, on the whole, fairly like that of the mammal. The acetabular portion is large, and there is no evidence of a cotyloid notch in the articulation. A little distance below the articular portion the bone is considerably constricted, and then widens out into a broad fan-like expansion. The posterior border of the bone is nearly straight, being only slightly concave at its upper part. It is fairly broad and slightly hollowed out. Probably the anterior half of the lower border of the bone formed part of the symphysis with its neighbour. If this is so, then the part of the symphysis formed by the ischium in *Diademodon* would be considerably less than in *Cynognathus*.

The obturator foramen is of large size, as in mammals generally. It is relatively about as large as in *Echidna*, and rather larger than in *Cynognathus*.

The following are some of the principal measurements of the pelvis:—

	millim.
Antero-posterior length of iliac crest ...... about	68
From lowest point of ilium to nearest point of iliac crest	40
Width of acetabular portion of ilium	30
Greatest length of pubis	38
Greatest length of ischium	47

The femur is fairly well preserved, and is especially interesting since the Theriodont femur has not hitherto been very well known. The imperfect proximal end of the femur of *Cynognathus* has been described by Seeley, and he has also described a fairly good femur of *Tribolodon* showing the anterior and outer surfaces. The femur of *Diademodon* as developed shows the posterior, outer and inner sides, so that it fills up the blanks in our knowledge of the bone. The proximal end of the femur is, as in *Cynognathus*, greatly expanded owing to there being no neck, and the large trochanter major being thus continued on to the articular head. If we regard the condyles as pointing backwards, then the expanded proximal end of the bone is directed backwards and outwards from the head, and the trochanter major, which forms the outer end of the expansion, points almost directly outwards. There is thus left in front of the trochanter a concavity. Along the posterior part of the inner side of the upper third of the shaft there is developed a prominent ridge which is directed backwards and slightly inwards. Superiorly it ends abruptly about the level of the lower part of the head and forms the trochanter minor. It will thus be seen that the upper part of the Theriodont femur bears a greater resemblance to that of the mammal than to that of either the Therocephalian or Anomodont. In *Oudenodon* the proximal end of the femur agrees with that in

Diademodon in having no notch between the head and the trochanter major, but differs in having the trochanter minor very feebly developed. On the whole the mammalian femur which most resembles that of *Diademodon* is the femur of *Echidna*. In *Echidna*, however, the trochanter major is less strongly developed, the head has a distinct neck, and the trochanter minor is directed more inwards than backwards. But these points are not of much importance, as they are found to vary greatly according to the habits, in even closely allied mammals; and there is little doubt that the femur in *Echidna* is fundamentally similar to that in *Diademodon*. In *Phascolomys* the small trochanter gives the proximal end a superficial resemblance to that of *Diademodon*, but the two bones are not very closely related. A more important affinity is seen in the femur of *Dasypus*. Here the small trochanter resembles considerably that of the Theriodont, and the trochanter major is similarly directed forwards. The presence of the third trochanter, however, and the deep depression in the head for the teres ligament show that the two bones are possibly not any more nearly related than are those of the Marsupial and Theriodont. At the lower end of the bone the condyles are more developed than in *Echidna* and less than in *Phascolomys*. The cartilaginous surface can be traced from the one condyle to the other over the intercondylar hollow. From the shape of the portions of the condyles preserved, I think one is justified in concluding that *Diademodon* stood, when at rest, with the femur directed downwards and forwards, making an angle of 45° with the surface of the ground. In this respect it agrees with Anomodonts and Mammals generally.

The following are some of the principal measurements of the femur:—

		millim.
Greatest length	about	91
Width of proximal end	,,	37
Width of middle of shaft	,,	8·5

The small vertebra which is preserved is believed to be one of the last of the dorso-lumbar series. In structure it is exceedingly mammal-like. The centrum seems to be about as broad as long, but is apparently much broader in front than behind, owing to the autogenous transverse process or rib being attached to the side of the anterior point of the centrum. This transverse process has a very large attachment, the lower part of which is anchylosed to the centrum and the upper part to the arch. There is apparently a small foramen passing from front to back near the line of the suture of the arch and the centrum, and in reality making the transverse process or rib double-headed. A part of the inner end of the transverse process comes a little further forward than the anterior end of the centrum and appears to form a slight articulation with the centrum in front. Passing outwards the transverse process becomes slender and is directed forward. Whether it after-

wards expands and curves backwards as in *Cynognathus*, the evidence does not show. The zygapophyses of the two sides are fairly close together, and the articular surface of the post-zygapophysis looks downwards and outwards. Below the post-zygapophysis is a small but distinct anapophysis. The vertebra bears a fairly close resemblance to the posterior dorsals or lumbars of *Cynognathus* and *Microgomphodon*, but the base of the transverse process or rib is stronger in *Diademodon*. The mammalian vertebra which most closely resembles it is perhaps the presacral vertebra of *Dasyurus*. If the transverse process of this vertebra be proved to be autogenous as in *Phascolomys*, then the affinity with *Dasyurus* would be very manifest. The lumbar vertebræ, like all the other vertebræ in the Monotremes, are so much specialised and in some respects degenerate, that they are much less like those of the Theriodonts than are even those of the higher Eutherians.

EXPLANATION OF PLATE X.

Fig. 1. Side view of left dentary of *Diademodon mastacus*. Nat. size. *Pm.*, premolars; *m.*, molars.
Fig. 2. Upper surfaces of the seven lower molars of the right side. Nat. size.
Fig. 3. Inner view of left ilium. Nat. size.
Fig. 4. Outer view of left ischium. Nat. size.
Fig. 5. Inner view of left pubis. Nat. size.
Fig. 6. Restoration of left side of pelvis of *Diademodon*. ½ nat. size. *Il.* Ilium. *Is.* Ischium. *Pu.* Pubis.
Fig. 7. Back view of left femur. Nat. size. *G.T.* Great trochanter. *S.T.* Small trochanter.
Fig. 8. Upper view of lumbar vertebra of *Diademodon*. Nat. size.
Fig. 9. Side view of lumbar vertebra of *Diademodon*. Nat. size.

7. A Contribution to the Knowledge of the Arteries of the Brain in the Class Aves. By Frank E. Beddard, M.A., F.R.S., Prosector to the Society.

[Received January 19, 1905.]

(Text-figures 15–20.)

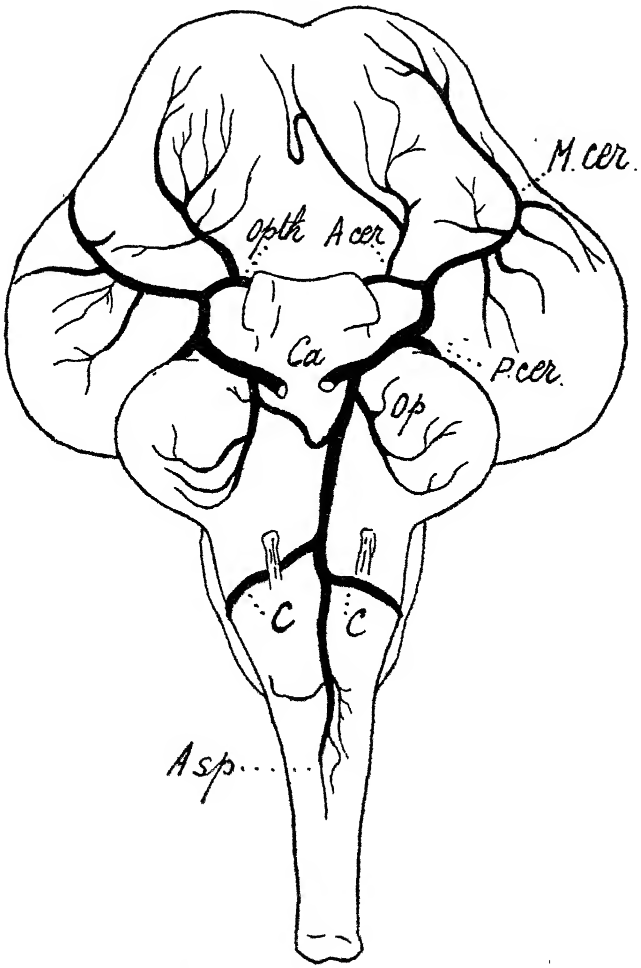
The course of the arteries of the base of the brain in birds does not appear to have been much studied. Dr. Gadow, in the section of Bronn's 'Thierreichs' devoted to birds, figures one brain from the ventral surface—a figure copied from a memoir by Neugebaur* on the vascular system generally in birds. I am not, however, acquainted with any comparative sketch of the cerebral arterial system in these animals. I believe, therefore, that the following observations, based upon the study of material skilfully injected by my assistant, Mr. E. Ockenden, will be of some use as a contribution to the subject.

Struthio masaicus ♂.—I shall give a detailed account of the brain of the Ostrich, which will enable me to be more brief in

* Nov. Act. Acad. Leop.-Car. xxi. 1845, p. 517.

the descriptions which follow. This brain is illustrated in the accompanying drawing (text-fig. 15), the accuracy of which can be tested by a reference to the actual specimen, which I have

Text-fig. 15.



Brain of *Struthio masaicus* (ventral aspect), showing the principal branches of the arterial system.

A.cer. Anterior cerebral artery; *A.sp.* Anterior spinal artery; *C.* Cerebellar arteries; *Ca.* Carotid arteries; *M.cer.* Middle cerebral artery; *Op.* Artery to optic lobe; *Opth.* Ophthalmic artery; *P.cer.* Posterior cerebral artery.

handed over to the Museum of the Royal College of Surgeons, where will also be found some of the other brains described here.

The *basilar* artery and the *anterior spinal* artery are quite continuous. The junction of the two appears to be marked by the exit of what I presume to be the homologue of the mammalian *vertebral* arteries. These arteries join the longitudinal vessel on either side in a rather remarkable way. The point of entrance is not lateral, but ventral and median, that of the left side entering posteriorly to the right-hand vessel. These latter, moreover, give off a forwardly-running branch, which diminishes in calibre and effects a second junction with the basilar artery just at the point where the latter receives the right cerebellar artery; this entrance into the basilar is also ventral and median. The minute details being perhaps individual are not shown in the figure. The *anterior spinal* artery is double for a considerable distance behind the entry of the vertebral arteries; the two tubes, however, reunite. Both the anterior spinals give off a large number of small trunks to the adjacent regions of the medulla and spinal cord.

The *cerebellar* arteries (text-fig. 15, *C.*, p. 103) are large and conspicuous; the right-hand artery arises in front of that of the left side; this asymmetry, it will be noticed, exactly corresponds to that of the vertebral arteries—*i. e.*, the left vertebral artery, like the left cerebellar, is posterior to the right. Each cerebellar artery, before reaching the cerebellum, gives off a strong branch which forms the *posterior spinal* artery. Of these, at least four run side by side down the posterior face of the spinal cord, contrasting thus with the single or, at least only for a short space, double anterior spinal. The cerebellar arteries pass over the summit of the flocculus and supply all parts of the cerebellum. This region of the brain is, however, also supplied from other sources, which will be dealt with in due course.

The *basilar* artery divides into two just in front of the third nerves; but the left-hand branch is much the larger, and indeed the right-hand branch might easily escape attention.

The *carotid* arteries (text-fig. 15, *Ca.*, p. 103) lie at the side of the pituitary body, and of course behind the optic nerves; each artery divides into two branches. The posterior branch runs between the corpus bigeminum and the cerebellum, and receives immediately after its origin the basilar artery. It supplies both corpus bigeminum and cerebellum. The anterior branch curves round the optic chiasma and ends in the *ophthalmic* artery (text-fig. 15, *Opth.*) of its own side: there is thus no completed circle of Willis. This main anterior trunk of the carotid has three branches. The first runs between the corpus bigeminum and the cerebral hemisphere, and along the inter-hemispheral sulcus, giving off branches also to the cerebellum. The middle cerebral artery is rather larger than the posterior. It runs along the depression which has been compared to the Sylvian fissure, giving off branches right and left. It bifurcates, just at the junction of the lower surface of the brain with the upper, into two main branches, of

which the anterior bends inwards and gives off branches which anastomose with those of the anterior cerebral. The latter artery is about equal in size to either the middle or the posterior cerebral, and arises along the circle of Willis some way in front of the middle cerebral. The two anterior cerebrals anastomose anteriorly in the middle ventral line of the brain.

Dromæus novæ-hollandiæ.—A beautifully injected brain of this species shows some differences from that of the Ostrich.

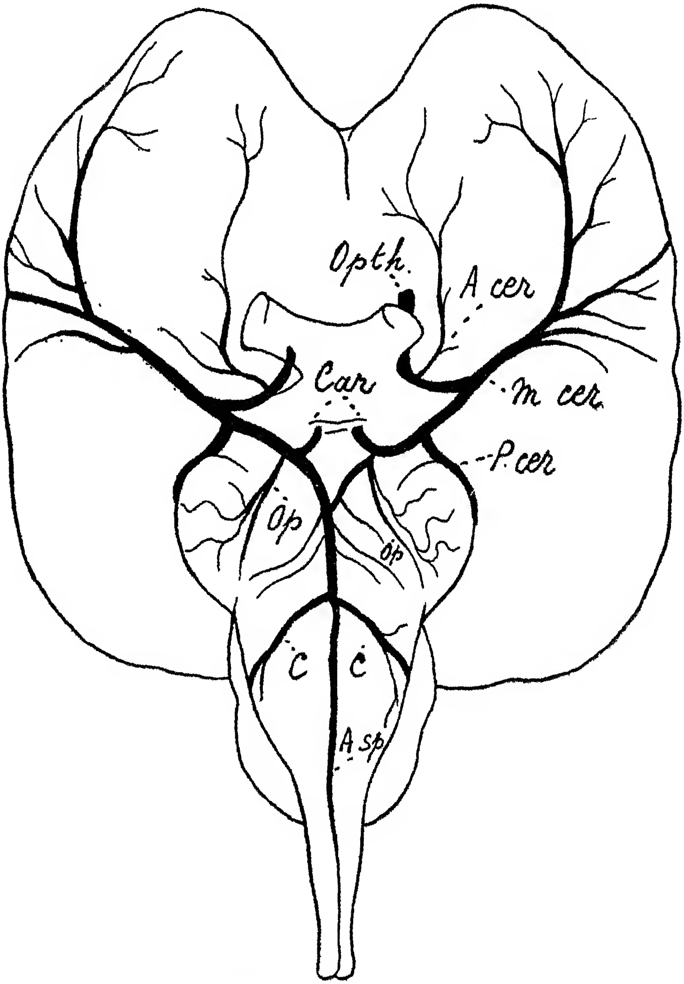
The space enclosed by the anterior bifurcation of the spinal artery and the reunion of the vessels to form the basilar artery is somewhat more extensive than in *Struthio.* There is an asymmetry in the relations of the cerebellar arteries to the trunk of which they are branches; but the asymmetry is different. The spinal artery arises from or joins the right cerebellar, and both of the cerebellar arteries lie in front of the sixth pair of nerves, instead of one in front and one behind as in *Struthio.* The bifurcation of the basilar artery anteriorly is rather peculiar in the specimen before me. There is the usual asymmetry, but it is unusual in its character. Just behind the optic chiasma the basilar artery bends to the right side of the brain and becomes continuous with the carotid in the usual way. About halfway between the point where the basilar artery becomes deflected to the right and its bifurcation posteriorly to form the cerebellar arteries, an artery of one-half of the diameter of the basilar arises from it on the left, and after giving off branches to the medulla runs forward and becomes connected with the left carotid. Anteriorly the carotids give off the usual arteries; but their main stem is the middle cerebral artery, which passes along the Sylvian fissure. The ophthalmic artery arises at the root of this, and immediately afterwards, apparently almost by a common stem with the ophthalmic, the anterior cerebral. This artery divides on each side into two branches, fairly equisized, of which the inner supplies the olfactory bulbs, which are here large. It is as well developed as in *Goura* (described below), and much more conspicuous than the minute corresponding artery of *Struthio.* The outer branch of the anterior cerebral again divides into two equisized branches, as is the case with *Struthio.*

Ara hyacinthina (text-fig. 16, p. 106).—The anterior spinal artery is single throughout and slender, but shows no such great disproportion in calibre to the basilar artery such as is apparent, for example, in the Penguin, *Spheniscus demersus*, described below. It is, however, rather more slender than the basilar artery. The two arteries do not pass directly into each other; for the anterior spinal opens into the left cerebellar artery, quite close, however, to its point of origin from the basilar artery. The cerebellar arteries, with the slight exception just mentioned, are symmetrical and arise behind the origin of the sixth pair of nerves.

It is important to note that in this bird the basilar artery is

connected with both carotids, and thus the circle of Willis is completed posteriorly. Nevertheless there still remains an asymmetry in that the two posterior communicating arteries are of unequal size. The right artery, in fact, is more than twice the diameter

Text-fig. 16.



Brain of *Ara hyacinthina* (ventral aspect), showing the principal branches of the arterial system.

Car. Carotids; other lettering as in text-fig. 15.

of the left. In both cases the posterior communicating artery gives off the artery to the optic lobe of its side before joining the

carotid. This arrangement contrasts with that to be observed in the Penguin, where the origin of the artery of the corpus bigeminum is in front of the junction of the carotid artery with the circle of Willis.

Each artery to the corpus bigeminum divides, first of all, into two principal branches, which do not, however, correspond exactly with the two branches of the same artery, for example, in *Spheniscus* (described below); for in *Ara* the anterior branch supplies both the median and anterior regions of its corpus bigeminum, and the general lie of the arteries is quite different, as will be seen on a comparison of text-figs. 16 (p. 106) & 18 (p. 110). Both branches are equisized and are symmetrical on the two sides of the brain. They run parallel with each other for a considerable distance after the origin of the main stem from the circle of Willis. The circle of Willis has a more markedly triangular shape in this Macaw than in many birds; and the transverse diameter of the triangle is greater than its antero-posterior diameter. A comparison of text-figs. 16 (p. 106) & 20 (p. 115) will illustrate this peculiarity in the circle of Willis of *Ara*.

The middle cerebral arteries are the most important of the three cerebral arteries arising on each side. Each springs from a basal angle of the triangular circle of Willis. At the end of the "Sylvian fissure" each vessel splits into three or four trunks, of which that which bends inwards towards the middle ventral line cannot be said to form the main stem of the artery, any more than can the others. The posterior cerebral artery arises just behind the middle. The anterior cerebral artery is a much more slender artery than either of the others, and it arises further away from the origin of the middle cerebral than is usual among birds, where the extreme opposite is shown in *Gymnorhina*, by the common origin of both anterior and middle cerebrals.

Syrnium aluco.—The most characteristic feature of the arteries in this bird is the marked symmetry of their arrangement, which, as will have been and will be noted, is not by any means usual among birds. The posterior spinal artery is only double for a short distance. The cerebellar arteries arise exactly opposite to each other and in front of the 6th nerve. The two branches of the basilar which form the posterior communicating arteries are perfectly equal in size. The ophthalmic arteries form the anterior termination on each side of the carotids; they arise from the circle of Willis just opposite the middle cerebral arteries, which supply the whole of the fore part of the hemisphere; there are no independent anterior cerebral arteries. The broader and shorter cerebral hemispheres of *Syrnium* are correlated with a somewhat different branching of the middle cerebral arteries. Each artery is curved in a semicircular fashion, and follows a transversely-running forward branch of the Sylvian fissure, to end in the immediate neighbourhood of the olfactory lobes. Only one branch of importance is given off from the inner side of each semicircle

thus formed. These are the rather strongly developed olfactory arteries, which meet but do not join in the median intracerebral fissure, along which they run towards the olfactory bulbs.

The brain of *Asio mexicanus* shows no differences, except in the merest minutiæ.

Text-fig. 17.

Brain of *Pelecanus fuscus* (ventral aspect), showing the principal branches of the arterial system.

Lettering as in text-fig. 15.

Aquila verreauxi.—The brain of this bird shows the more general avian asymmetry in some of its arteries. Thus the anterior spinal, which is double for some distance, enters the left cerebellar artery instead of being directly continuous with the basilar trunk. The basilar artery, moreover, is connected with the right carotid only, or if with the left also by a quite minute trunk, which I have not

been able to see. The middle cerebral (Sylvian) artery curves round on each side towards the middle line, but not with so marked a flexure as in the Owls.

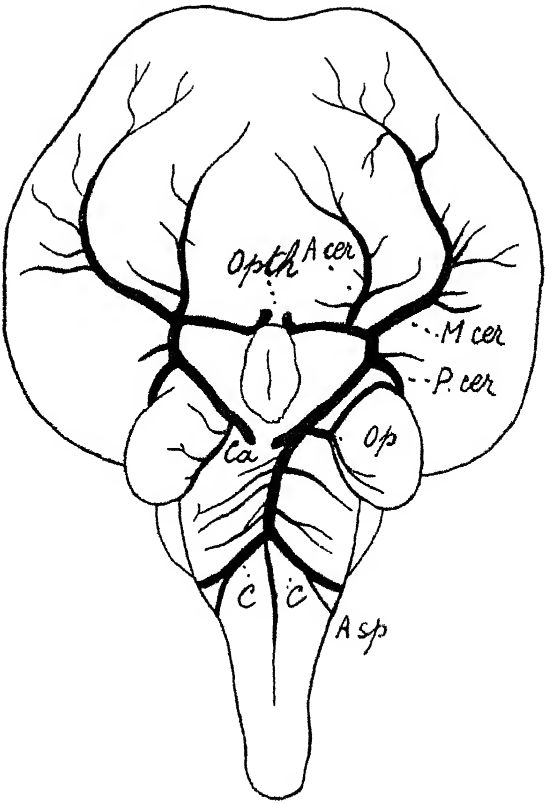
The brain of *Falco lanarius* differs in some few particulars from that of *Aquila*, but agrees in other points. The cerebellar arteries are not asymmetrical, but the basilar is, though its asymmetry is different. It communicates, in fact, chiefly if not entirely with the left carotid instead of the right. The main branch of the Sylvian shows the same flexure as that of *Aquila*.

Pelecanus fuscus (text-fig. 17, p. 108).—One marked feature of this brain is the absolutely unpaired character of the anterior spinal artery, in the course of which I could detect no bifurcation and reunion. The cerebellar arteries arise behind the 6th nerve and are slightly asymmetrical, the right being in advance of the left. The main peculiarity of these arteries is the fact that on the right side the posterior spinal artery does not arise as a branch of the cerebellar, but as a separate trunk from the basilar artery. On the left side the artery is not thus independent, but arises very early from the cerebellar. The main trunk of the basilar is continued into the left side of the circle of Willis. The circle terminates on either side anteriorly in an unusual way. The ophthalmic arteries (text-fig. 17, *Opth.*) do not, as is the rule with birds, arise in front of the optic chiasma and form practically the anterior termination of the circle of Willis. *They resemble those of mammals, in arising between the origins of the posterior and middle cerebral* (Sylvian) *arteries*. The anterior cerebral artery divides on each side into two branches. On the left side the second, innermost, branch is the main trunk, and passes along the inter-hemispheral groove to the olfactory bulbs, which are very little marked.

Spheniscus demersus (text-fig. 18, p. 110).—In this brain the anterior spinal and the basilar arteries are nearly perfectly continuous, and the former is in no place double, as it so frequently is in other birds. The junction of the anterior spinal artery with the basilar is effected through the right cerebellar artery, an asymmetry which is common in the avian brain. The basilar artery has a much greater calibre than the ensuing anterior spinal, quite three times as great. The anterior spinal also contrasts, by its slenderness, with the two stout cerebellar arteries, each of which is considerably more than half the diameter of the parent basilar artery. The cerebellar arteries arise from the basilar artery behind the point of origin of the sixth pair of cranial nerves. Anteriorly the basilar artery bends to the left and becomes continuous with the carotid; there is no trace, that I could discover, of a bifurcation and a branch to the right carotid. From each half of the incompleted circle of Willis four principal arteries and one of minor importance arise, before the circle ends anteriorly in

the ophthalmic arteries. The first of these is the artery to each optic lobe, which arises anteriorly to the junction between basilar and carotid. The artery, after arising from the carotid, divides at once into two; these branches were of equal size on the left side of the brain, but the posterior of the two was much the larger on the right side of the brain. The two branches supply respectively the anterior and posterior face of each corpus bigeminum.

Text-fig. 18.



Brain of *Spheniscus demersus* (ventral aspect), showing the principal branches of the arterial system.

Lettering as in text-fig. 15.

The three following arteries which arise from the carotid are the posterior, middle, and anterior cerebral. Just in front of the posterior cerebral is a smaller accessory trunk, which also supplies the cerebrum. The chief trunk of the middle cerebral artery

bends inwards and runs in a course which is exactly parallel to the anterior cerebral artery.

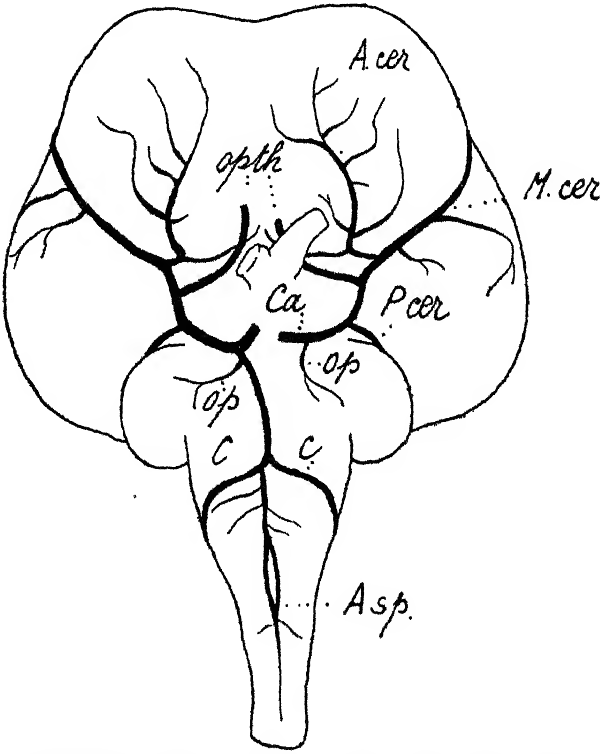
Cathartes atratus.—The brain arteries of this New-World Vulture differ from those of the Old-World Falconidæ described above in a variety of points. In the first place, the anterior spinal artery is single and joins the basilar with the merest trace of asymmetry Anteriorly the basilar divides into two branches, of which that going to the left carotid is rather the larger. Anteriorly, again, the carotid divides into the ophthalmic and the common trunk of the middle and anterior cerebrals. In *Aquila* and *Falco* the anterior cerebrals do not arise in this way, but separately and anteriorly from the ophthalmics, as is the case with many other birds also. The middle cerebrals do not curve round to meet each other towards the middle line, but run straight forward in a way much more characteristic of the Cranes.

Psophia leucoptera.—I have examined two brains of this species which show an absolute agreement in all characters of importance, and indeed only one point of difference that I was able to detect. This concerns the junction of the anterior vertebral artery with the basilar at the point where the latter is formed by the convergence and union of the cerebellar arteries. One specimen was very nearly symmetrical in this region, the other less so. In the former, the anterior spinal artery communicates with the basilar only partly and indirectly by way of the left cerebellar. In the second specimen, the point of opening of the anterior spinal was also into the left cerebellar, but further away from the point of union of the two cerebellar arteries. Posteriorly, as in *Anthropoides paradisea* and some other birds, the anterior spinal artery is double. I only observed this in one specimen, but should not like to record it as a variation, since the apparent difference may be merely a question of deficient injection. In both specimens the circle of Willis is, as in so many other birds, asymmetrical. The basilar artery is, in fact, connected only with the right carotid, as is the case with *Anthropoides paradisea.* Just before joining it the basilar gives off the artery to the corpus bigeminum of its own side. The middle cerebral artery curves round, as in the Birds of Prey, towards the middle ventral line of the brain to the extremely rudimentary olfactory lobes, nearly meeting its fellow. In this feature *Psophia* distinctly differs from *Anthropoides paradisea.* The anterior cerebral arteries arise about halfway between the origin of the middle cerebrals and the middle line of the brain. They are slender and not conspicuous.

Tantalus ibis.—The brain of this bird (text-fig. 19, p. 112) which I examined is particularly well injected, and shows apparently all the small arteries as well as the larger ones. The anterior spinal artery (text-fig. 19, *A.sp.*) is double for a portion of its course, but

only for a short portion, and the two arteries reunite a considerable distance behind the junction of the cerebellar arteries to form the basilar. The anterior spinal artery is at its point of union with these arteries slightly asymmetrical. In fact it joins the right cerebellar artery, though only just before the union of the latter with the left. The two cerebellar arteries are themselves symmetrical with regard to the ventral median line of the brain; the right-hand one, at any rate, lies in front

Text-fig. 19.



Brain of *Tantalus ibis* (ventral aspect), showing the principal branches of the arterial system.

Lettering as in text-fig. 15.

of the 6th nerve. I could not detect the nerve on the other side of the brain. The cerebellar artery divides into the two usual branches. That which supplies the medulla is connected with a coarse network of arteries on the upper surface of that part of the brain which puts the artery into communication with its fellow on the opposite side of the brain. The basilar artery gives off a

branch on the right side to form or join the circle of Willis; on the opposite side is a very slender equivalent artery. The ophthalmic (text-fig. 19, *Opth.*, p. 112) arises from the circle of Willis in a way which is found in some other birds, but not in all. Each artery arises from the circle of Willis before the latter gives off the middle cerebral artery. The anterior cerebral is therefore quite independent of the ophthalmic artery, instead of being a branch of it as it is, for example, in the Ostrich. *Tantalus* agrees more nearly with *Pelecanus* than with some other birds in the disposition of these arteries. The middle cerebral artery gives off as usual a large series of branches, but there is not an especially conspicuous one curving round towards the middle ventral line of the brain as in so many birds. This region of the brain is, in fact, supplied by the anterior cerebral artery (text-fig. 19, *A.cer.*). This artery has two chief branches: the one runs forward towards the olfactory lobes; the other runs along the groove lying in front of the optic chiasma and nearly meets its fellow of the opposite side. The position occupied by this artery is, in fact, exactly that which is often occupied by the ophthalmic arteries in other birds. It is remarkable that in the Ostrich (text-fig. 15, p. 103) the ophthalmic does occupy this position, and that, further, an artery arises from the circle of Willis exactly in the position of the ophthalmic artery in *Tantalus*, and runs to the optic nerve on either side. This artery lies above the ophthalmic, and is shown on the right side only in the figure (text fig. 15, p. 103).

Anthropoides paradisea.—In this Crane I have been able to study the brain arteries in considerable detail; the injection had been very successful. The anterior spinal artery shows the very usual bifurcation and reunion before uniting with the cerebellar arteries to form the basilar. The reunion takes place some little way behind the entrance of the anterior spinal artery into the right cerebellar artery. This union, it will be observed, is, as in so many other birds, the cause of an asymmetry in this region of the vascular system of the brain. The basilar artery gives off in its course two pairs of quite symmetrically disposed arteries to the medulla. The basilar artery itself only supplies the right side of the circle of Willis.

Cariama cristata.—The anterior spinal artery in *Cariama* is, as is usual among birds, unsymmetrical with regard to the basilar artery; it is not in the same straight line with it, but joins the right cerebellar. Towards the end of the medulla the anterior spinal is double, the right-hand half being, however, the more important. The calibre of the anterior spinal is less than that of the basilar artery, but the difference is not so great as in some birds, for example the Penguin. The basilar artery does not bifurcate anteriorly, but joins the right side of the circle of Willis only; just before joining it emits the artery to the right optic lobe. The cerebellar arteries—at any rate that of the left side—arise in

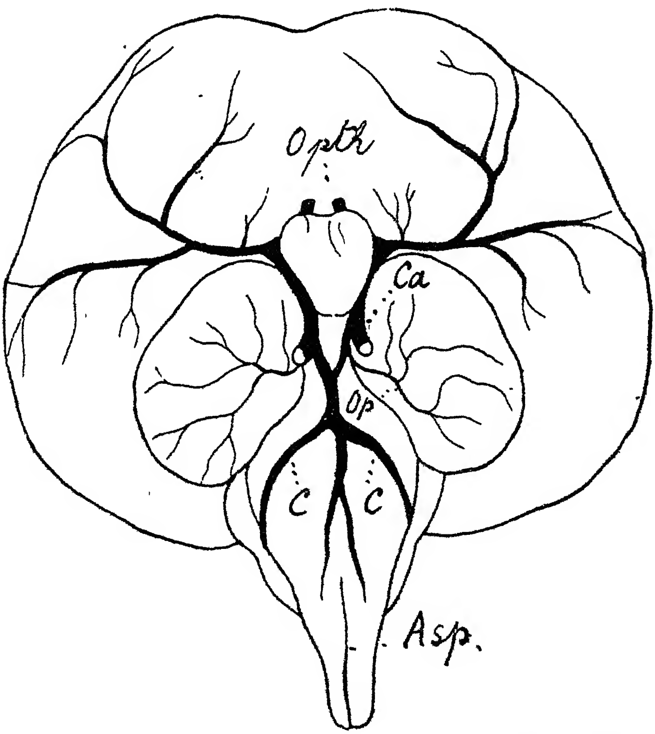
front of the sixth nerves. The arteries of the corpora bigemina are nearly symmetrical with each other; each divides into two branches just before reaching its corpus bigeminum. Of these branches the anterior is the smaller. There is nothing specially noteworthy to record concerning the cerebral arteries.

Goura coronata.—In this bird the two vertebral arteries reach the brain just behind the medulla; before passing forward they give off, as in the case of many mammals (as, for instance, Man), a very delicate anterior spinal artery, thereby contrasting with many birds, where the anterior spinal is of as great a calibre as the basilar artery. The vertebrals then run forwards separately, and unite to form the basilar artery well behind the origin of the cerebellar arteries. The latter arise much further forwards than in the Ostrich (described above, p. 103). Furthermore, the branch of this artery which runs backward along the lateral aspect of the medulla differs from that of the Ostrich in its relation to the adjacent nerve; moreover, the main continuation of the artery to the cerebellum has also a different relation to adjacent nerves. A final difference in the arterial system of this region of the brain is that, while in the Ostrich the main branch of the cerebellar artery passes over the flocculus and is distinctly the most important artery of the cerebellum, in *Goura* the artery which follows the same course is not derived from the posterior cerebellar, but from an anterior cerebellar arising from the basilar artery further forwards, and which is of the same calibre as the posterior cerebellar. This artery exists in the Ostrich, but is not nearly so large as the posterior cerebellar. The posterior cerebellars, it should be observed, arise symmetrically from the basilar; the left anterior cerebellar arises in advance of the right anterior cerebellar. As in the Ostrich, the left posterior communicating artery is much the stronger. The anteriorly situated cerebral arteries have a curiously asymmetrical and compensative arrangement. As in other birds, the carotids curve round and each ends in the ophthalmic artery. The main cerebral arteries are three in number. The first two of these are exactly as in *Struthio*, lying respectively between the cerebrum and the corpus bigeminum and along the Sylvian fissure. The third artery, however, consists of two branches, of which the more important approaches its fellow of the opposite side and runs mesially forward to the olfactory lobes; the branch running forwards and supplying the under surface of the hemisphere to the side of this is less important. In *Struthio* the precise reverse is the case. Moreover, this branch, lying to the side of the olfactory branch of the anterior cerebral artery, is only well developed on the right side; it exists on the left side, but is functionally replaced on that side by a branch of the middle cerebral artery. This branch is present on the right side but very small.

Gymnorhina leuconota.—There are a number of features (see

text-fig. 20) in which the encephalic arterial system of this bird differs from that of other birds. The anterior spinal is double for a considerable distance behind the origin of the cerebellar arteries; but I am unable to be precise as to the extent of this double region. The anterior spinal artery is not exactly in the same straight line with the basilar artery, but joins directly the left cerebellar artery. There is thus, as is so often the case, an asymmetry in the cerebellar arteries; but the most remarkable peculiarity concerning these arteries is that they rise very near to the circle of Willis, and therefore well in front of the origin of the sixth pair of nerves.

Text-fig. 20.



Brain of *Gymnorhina leuconota* (ventral aspect), showing the principal branches of the arterial system.

Lettering as in text-fig. 15.

The basilar artery joins the right side of the circle of Willis only. The latter is more elongated in an antero-posterior direction than it is in many birds.

The posterior cerebral artery among birds usually hides itself

deep down in the cleft between the corpus bigeminum and the cerebrum. In *Gymnorhina* the conditions are rather different. The artery in question at least mainly supplies the corpus bigeminum of its side, and can be seen running over the anterior face of that division of the brain. Another unusual characteristic shown in the brain is the origin from a common stem of both the middle and anterior cerebral arteries. The latter, as will be seen from the drawing, are particularly small. The middle cerebral arteries have three main branches; but it is possible that the innermost branch is to be looked upon as the true anterior cerebral artery, since its distribution agrees very closely with a separately arising artery in many birds (see text-figs. 16, 18, *A.cer.*, pp. 106 & 110), which I have ventured to call anterior cerebral.

§ *General Account of the Cerebral Arterial System in Aves.*

From the details set forth in the preceding descriptions of various types of birds' brains, it is possible to extract a general account of the arteries as characterising birds.

The *circle of Willis* is never fully complete; it is invariably incomplete anteriorly, there being no anterior communicating artery as in mammals; posteriorly the asymmetrical disposition of the basilar artery usually (but not always) fails to bring about a direct union between the two carotids.

The *two Carotids* are invariably both present and are posterior in position, never entering the imperfect circle of Willis towards the middle of its course. They are also perfectly symmetrical with each other and equisized. They lie behind the last cerebral artery, and not, as in mammals, between the middle and the posterior cerebral artery. They are alone concerned with the circulation in the brain, the vertebral arteries being unimportant.

The *Ophthalmic arteries* are always large and symmetrical, and their position varies slightly, arising as they do either behind the origin of the middle and anterior cerebrals or in common with the latter. In the former case, the point of origin of the ophthalmic arteries resembles that of the Mammalia. In the latter, which is the more usual, the condition is typical of birds as opposed to mammals. They are never small and inconspicuous as is the case in some mammals.

There are invariably three pairs of *Cerebral arteries*, of which the anterior is distinctly less important than the middle and the posterior, and its supply of blood to the hemispheres is limited to the anterior and inferior regions of the hemispheres and to the rudimentary olfactory lobes. The cerebral arteries are the only arteries supplying the brain which arise from the circle of Willis. The intercerebral region is not supplied, as in mammals, by the anterior cerebral artery, but by the middle and posterior.

There is one principal *Cerebellar artery* on each side, arising from the basilar artery where the latter becomes continuous with the anterior spinal artery at about the middle of the medulla, and

as a rule, but not always, in front of the sixth nerves. The position of these arteries is nearly exactly that of the middle cerebellar arteries in Mammalia. Each cerebellar artery emits a considerable branch to the dorsal side of the spinal cord before passing, as it almost always (if not quite always) appears to do, over the flocculus. The cerebellum is also supplied with blood by a branch of the artery supplying the corpora bigemina and by a branch of the posterior cerebral artery.

The *Basilar artery* is short in extent, and is as a rule connected with only one carotid, either right or left, though sometimes with both. This asymmetrical condition of the basilar artery is very rarely to be seen in Mammals, but it is quite characteristic of Birds.

The following synopsis shows the connection of the basilar artery with the circle of Willis in the types examined:—

Basilar artery bifurcate anteriorly, completing circle of Willis posteriorly.

a. Branches equal or subequal: *Syrnium*, *Asio*.

b. Left-hand branch larger: *Struthio*, *Cathartes*, *Goura*.

c. Right-hand branch larger: *Dromæus*, *Ara*, *Tantalus*.

Basilar artery connected with right side only of circle of Willis: *Aquila*, *Psophia*, *Anthropoides*, *Cariama*, *Gymnorhina*.

Basilar artery connected with left side only of circle of Willis: *Falco*, *Pelecanus*, *Spheniscus*.

I am unwilling to comment at length upon these facts since they are but few. They allow, however, of some obvious reflections and some generalisations which can hardly be reversed by subsequent discovery. On the assumption (which seems to be reasonable) that the complete and equal division of the basilar artery anteriorly to join both carotids is primitive, it seems certain that the production of an asymmetry due to the shrinking or complete suppression of one branch has proceeded along several distinct lines, quite irrespective of such relationships as other anatomical characters allow us to surmise. That *Aquila* and *Falco* fall into different categories is sufficient proof of this. On the other hand, the fact must not be lost sight of that the Crane-like birds (viz., *Psophia*, *Cariama*, and *Anthropoides*) have apparently followed the same path of modification.

It is furthermore interesting to note that the Striges are unlike the Falcones, and that *Cathartes* is unlike either.

February 21, 1905.

Howard Saunders, Esq., Vice-President, in the Chair.

The Secretary read the following report on the additions that had been made to the Society's Menagerie in January 1905:—

The registered additions to the Society's Menagerie during the month of January were 70 in number. Of these 24 were acquired by presentation, 3 by purchase, 31 were received on deposit, and 12 by exchange. The total number of departures during the same period, by death and removals, was 158.

Amongst the additions special attention may be directed to the following:—

1 A Red Teetee (*Callithrix cuprea*) from Brazil, deposited on Jan. 18th. This species is new to the Collection.

2. Representatives of two unknown species of *Lemur* from Madagascar, deposited on Jan. 25th.

3. A pair of Mouflon (*Ovis musimon*) from Corsica, deposited on Jan. 21st.

4. A Prongbuck (*Antilocapra americana*) from North America, deposited on Jan. 14th.

5. An Ethiopian Wart-Hog (*Phacochœrus æthiopicus*) from Africa, deposited on Jan. 13th.

6. Two Black-and-White Geese (*Anseranas semipalmata*) from Australia, received in exchange on Jan. 23rd.

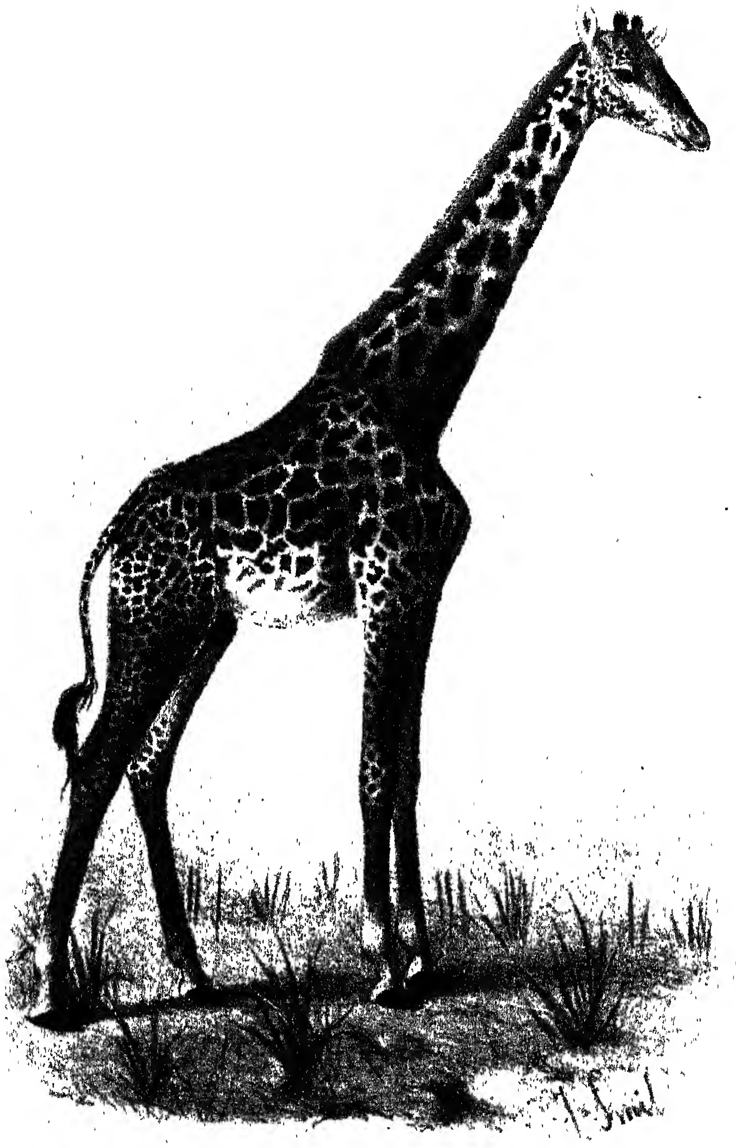
Mr. Henry Scherren, F.Z.S., exhibited on behalf of Mr. Rowland Ward, F.Z.S., a mounted specimen of the Blackbuck (*Antilope cervicapra*) shot by the Crown Prince of Bhopal in Sept. 1904. The animal was remarkable for the extent and depth of the dark coloration, which not only covered the body but the whole of the face, obliterating the usual white eye-patches. No such case was mentioned by Mr. Lydekker in his 'Great and Small Game of India,' and the skin was by far the darkest which had passed through Mr. Ward's hands. The horns measured 24¾" in length, with a circumference of 5½" at the base.

Mr. R. I. Pocock, F.Z.S., exhibited some specimens of the South-African Millipede (*Spirostreptus pyrocephalus*), presented by Mr. Guthrie, of Port Elizabeth, to the Society's Gardens. These Millipedes had bred in the Gardens.

Mr. G. A. Boulenger, F.R.S., read a paper entitled "A Contribution to our Knowledge of the Varieties of *Lacerta muralis* in Western Europe and North Africa."

This paper will be published entire in the Society's 'Transactions.'

The following papers were read:—



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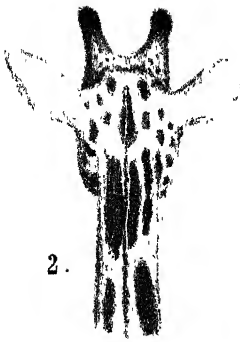
GIRAFFA CAMELOPARDALIS TIPPELSKIRCHI.
(*Immature female.*)

P Z.S 1905, vol I. Pl. XII



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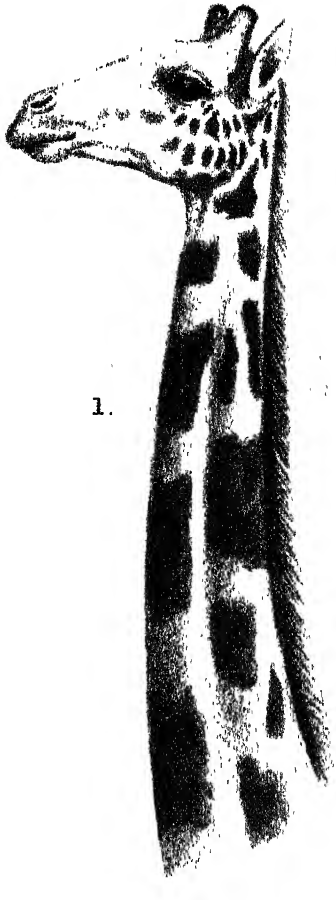

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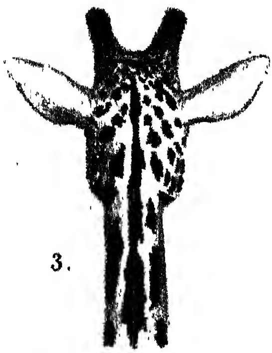

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Figs. 1, 2. HEAD AND NECK OF GIRAFFA CAMELOPARDALIS PERALTA
Fig. 3. BACK VIEW OF HEAD OF G.C. COTTONI.

1. On the Nigerian and Kilimanjaro Giraffes.

By R. Lydekker.

[Received January 7, 1905.]

(Plates XI. & XII.*)

Since the appearance in last year's 'Proceedings' † of my paper on the subspecies of *Giraffa camelopardalis*, the British (Natural History) Museum has received the skins and portions of the skeletons of two Giraffes belonging to forms hitherto insufficiently represented in the collection. The descriptions and figures of these two specimens will serve to complete the aforesaid paper, so far as anything connected with the zoology of mammals can be said to be complete.

The first specimen comprises the skin, skull, and limb-bones of an adult bull of the Nigerian, or western, race of the Giraffe (*Giraffa camelopardalis peralta*), shot by Captain G. B. Gosling in Nigeria, and presented by that gentleman to the Museum. The head and neck have been mounted, and form the subject of Pl. XII. figs. 1 & 2. The second specimen is a female (apparently not full-grown) of the Kilimanjaro Giraffe (*G. c. tippelskirchi*), presented by Mr. T. F. Victor Buxton, by whom the animal was killed in British East Africa last year. Of the former race, the only example hitherto known is the type female, of which the skull and limb-bones were alone preserved; while of the second no coloured figure has, so far as I am aware, been hitherto published.

Captain Gosling's specimen, which is that of a fully adult, although not a very old, animal, serves to show that the Nigerian Giraffe belongs to the northern, or typical, group of the species—that is to say, the one in which the bulls have a large median horn, and the legs in both sexes are white, or nearly so. When describing the skeleton of the type female, Mr. Thomas ‡ was of opinion that the lengths of the skull and of the hind cannon-bone indicated an unusually large form of Giraffe. This, however, is not borne out by the corresponding bones of the male. The skull of the latter is, for example, not very markedly larger than that of a Nubian or Kordofan Giraffe of the same approximate age. As regards the hind cannon-bone, this element in Captain Gosling's specimen is practically the same length as in the type female skeleton; and both these bones are scarcely longer than the corresponding bone in the mounted skeleton of a male Nubian Giraffe from Abyssinia in the British Museum. All that the Nigerian specimens seem to show in this respect is that the skull and the cannon-bone have the same respective lengths in both sexes. Whether this holds good for other races of the species, I have no means of determining.

* For explanation of the Plates, see p. 121.

† Proc. Zool. Soc. London, 1904, i. p. 202 *et seq.*

‡ *Ibid.* 1898, p. 40.

2. On Dolphins from Travancore. By R. Lydekker.

[Received December 30, 1904.]

(Plate XIII.*)

For some years past all specimens of Dolphins stranded on the shore or caught by the fishermen in their nets in the neighbourhood of Trevandrum, Travancore, have been collected and preserved by the officials of the Trevandrum Museum. This excellent work was begun by the late Director, Mr. Harold Ferguson, and, I am glad to say, is being continued by his successor, Major F. W. Dawson. In most cases careful measurements have been taken of the specimens in the flesh, while excellent coloured sketches have been made of the more important examples by Mr. C. S. Mudalear. After the completion of the measurements and drawings, the skeletons have been prepared—some of them, I am glad to say, having been presented to the British Museum.

As the result of the drawings and specimens sent to me by Mr. Ferguson, I have (in addition to representatives of other genera) been enabled to determine two apparently distinct species of the genus *Tursiops*, of both of which coloured figures have been published in the 'Journal of the Bombay Natural History Society'†. To the one I gave the name *T. fergusoni*; while the second I identified provisionally with the Australian *T. catalania*.

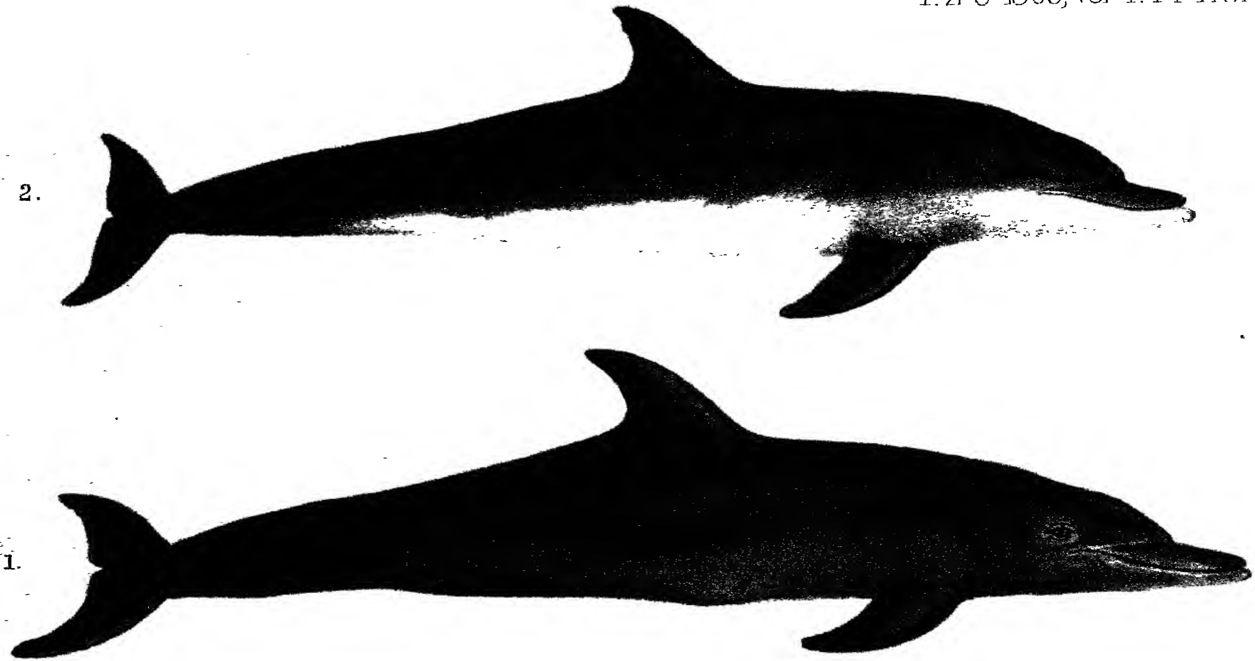
Since the publication of the second of the papers just referred to, I have received from Trevandrum sketches of two other Dolphins taken off that coast. The first of these (Plate XIII. fig. 1) is one of a pair taken in the autumn of 1903; while the second (Plate XIII. fig. 2) was captured in October 1904. Curiously enough, both appear to belong to the genus *Tursiops*; and, what is more curious still, they are unlike either of the two specimens figured in the papers referred to above.

Regarding the specimen taken in 1903, Mr. Ferguson wrote to me as follows:—

"I sent off last week a case containing the skeletons of two Dolphins caught here lately. They are of the same species, and I think of the genus *Tursiops*. They are very closely allied to, if not identical with, *T. catalania*; but they have no blotches at the sides, and they have a dark blue band running from the eye to the front of the adipose elevation, as in the common Dolphin. This band is much less conspicuous in the larger and older specimen, and may possibly disappear altogether with age. I send measurements of the two specimens, and a sketch of the larger one, in which the blue line is only faintly shown."

* For explanation of the Plate, see p. 128.

† Vol. xv. pp. 41 & 408, pls. B & C. It may be noticed that in the second of these papers no references are made to the first; this is owing to the fact that copies of the former had not been received in England at the time the latter was written.



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DOLPHINS FROM TRAVANCORE

The following is the description of these specimens as given by Mr. Ferguson :—

Descriptive notes on two Cetaceans caught at Villinjam in nets by fishermen on October 15th, 1903, and obtained by purchase.

Smaller specimen.

	ft.	in.
Length from tip of snout to the median cleft on the tail-flukes	5	10
From tip of snout to origin of dorsal fin	2	8
,, ,, pectoral fin	1	6
,, ,, genitals	3	10
,, ,, anus	4	3
Anterior margin of pectoral fin along the curve	1	2
,, ,, dorsal	1	0
Tail-flukes along the curve	1	$0\frac{1}{2}$
Expanse of tail	1	6
Beak from groove which separates the forehead	0	$5\frac{1}{2}$
Genital groove } close together	0	$4\frac{1}{2}$
Anus } close together	0	$0\frac{1}{2}$
Length of mouth from gape	0	$10\frac{1}{2}$
Greatest breadth	0	11
,, height	0	$11\frac{3}{4}$
,, circumference	3	1
Smallest circumference, at root of tail	0	$8\frac{1}{2}$
Height of dorsal fin	0	$7\frac{1}{2}$
Length of dorsal fin at base	0	$9\frac{1}{2}$

Lower jaw about half an inch longer than upper. Colour dark plumbeous, paler about the sides, reddish ashy below. A dark blue band running from the eye to the front of the adipose elevation on both sides, one inch broad at the eye, tapering to a quarter of an inch at the front. Genital and anal regions fleshy pink. Jellyfish in stomach.

Teeth $\frac{24}{25}$ and $\frac{24}{26}$ = 49 and 50.

Ribs 12 pairs, of which the first four pairs are two-headed. One ossified presternum and two mesosterna; xiphisternum membranous.

Vertebræ: C. 7, D. 12, L. 16, Ca. 23 = 58.

Pterygoids not in contact.

Larger specimen.

	ft.	in.
Length from tip of snout to the median cleft on the tail-flukes	6	8
From tip of snout to origin of dorsal fin	3	0
,, ,, pectoral fin	1	8
,, ,, genitals	3	$9\frac{1}{2}$
,, ,, anus	4	7

	ft.	in.
Anterior margin of pectoral fin along the curve.	1	3
,, ,, dorsal	1	$3\frac{1}{2}$
Tail-flukes along the curve	1	3
Expanse of tail	1	$7\frac{1}{2}$
Beak from groove which separates the forehead	0	5
Genital groove....................................	0	5
Anal opening	0	$1\frac{1}{4}$
Gape of mouth	0	11
Greatest breadth..................................	1	$0\frac{1}{2}$
,, height	1	$0\frac{1}{2}$
,, circumference	3	$2\frac{1}{2}$
Smallest circumference	0	10
Height of dorsal fin	0	$8\frac{1}{2}$
Length of dorsal fin at base	1	0
Greatest circumference	0	$10\frac{1}{2}$
Smallest circumference	0	$6\frac{1}{2}$

Lower jaw about half an inch longer than upper. Colour blue-black, paler at the sides; beneath fleshy grey. Lower jaw dull grey; a dark blue band, same as the smaller specimen, but less clear. Genital and anal regions fleshy pink.

Teeth $\frac{27}{28}$ and $\frac{26}{27} = 55$ and 53.

Vertebræ: C. 7, D. 12, L. 16, Ca. 23 = 58.

Ribs 12, of which five are two-headed.

Pterygoids not in contact.

The following are the particulars of the 1904 specimen supplied to me from the Trevandrum Museum:—

	ft.	in.
Extreme length	6	1
From tip of beak to origin of dorsal fin	2	$7\frac{1}{2}$
,, ,, ,, flipper	1	5
,, ,, anal opening..................	4	3
Length of flipper round the outer curve	1	2
,, dorsal fin	1	1
Expanse of tail-flukes............................	1	$4\frac{1}{2}$
Greatest height, including dorsal fin	1	$6\frac{3}{4}$
Height of body	1	0
Greatest girth....................................	3	3
Smallest girth....................................	0	9

Lower jaw somewhat protruding.

Colour. Upper surface, flippers, and sides of tail glistening dark brown, abruptly passing into dull silvery grey (paling into light sea-green after skinning) on the sides; facial region paler; under side dull pearly white, extending to a little behind the anal opening; orbits in a dark brown oval blotch, which gradually fuses into a tapering band running above and parallel to the basi-rostral groove and uniting at the angle of the (V-shaped) prenarial adipose elevation, from which four dark faint lines diverge towards

the forehead, the inner enclosing a pale lappet-shaped zone which includes the narial aperture, and the outer becoming obsolete halfway up.

Eyes dark reddish brown.

Lower jaw lighter than upper.

Lips dull whitish. Fins falcate.

Length of skull 16·3 inches; breadth 7·6 inches. Symphysis much shorter than one-fourth total length of mandible.

Teeth $\frac{27}{27}$ and $\frac{27}{26} = 54$ and 53. Simple, conical, and pointed, more or less compressed towards the root; antero-posterior diameter 6·5 mm. Two teeth in the premaxillæ, and the first two mandibular ones, which were concealed in the gum, much smaller (diameter 2 mm.).

In spite of its being a somewhat immature specimen apparently referable to the genus *Tursiops*, which it resembles in many respects, the pterygoids are widely separated in the middle line, with the posterior border divergent.

Vertebræ: C. 7, D. 13, L. 15, Ca. 25 = 60.

The atlas and axis only fused together.

Ribs 13, the first four two-headed.

Other characters as in *T. fergusoni*.

From the general characters of the specimen, the number and size of the teeth, the vertebral formula, and the relative shortness of the mandibular symphysis, I cannot but conclude that its reference to *Tursiops* is correct. It is true that in the divergence of the pterygoids it differs from the typical *T. tursio*; but since the same feature occurs in the specimen identified with *T. catalania*, this affords no grounds for generic separation.

In the following table are given the dental and vertebral formulæ of the Dolphins assigned to the genus *Tursiops*, inclusive of the present specimens :—

1. *Tursiops tursio* (Fabricius).

   Teeth $\frac{22}{22} = 44$.

   Vertebræ: C. 7, D. 13, L. 17, Ca. 27 = 64.

   Pterygoids in contact.

2. *Tursiops abusalam* (Rüppell).

   Teeth $\frac{26}{26} = 52$.

   Vertebræ: C. 7, D. 12, L. 16, Ca. 26 = 61.

   Pterygoids (?) in contact.

3. *Tursiops* sp. (Trevandrum, 1904.)

   Teeth $\frac{27}{27}$ and $\frac{27}{26} = 54$ and 53.

   Vertebræ: C. 7, D. 13, L. 15, Ca. 25 = 60.

   Pterygoids divergent.

4. *Tursiops fergusoni* Lydekker.
   Teeth $\frac{25}{25}$ and $\frac{26}{25}$ = 50 and 51.
   Vertebræ: C. 7, D. 13, L. 17, Ca. 24 = 61.
   Pterygoids divergent.

5. *Tursiops catalania* (Gray).
   Teeth $\frac{25}{25}$ = 50.
   Vertebræ: C. 7, D. 12, L. 15, Ca. 24 = 58.
   Pterygoids divergent (?).

6. *Tursiops parvimanus* Lütken.
   Teeth $\frac{25}{24}$ = 49.
   Vertebræ = 62.

7. *Tursiops gilli* Dall.
   Teeth $\frac{22}{22}$ and $\frac{23}{22}$ = 44 and 45.
   Vertebræ (?).

8. *Tursiops* sp. (Trevandrum, 1903.)
   Teeth $\frac{27}{28}$ and $\frac{26}{27}$ = 55 and 53, or (in young) $\frac{24}{25}$ and $\frac{24}{26}$ = 49 and 50.
   Vertebræ: C. 7, D. 12, L. 16, Ca. 23 = 58.
   Pterygoids divergent.

In this table no. 3 is the specimen figured in Plate XIII. fig. 2, and no. 8 the one shown in Plate XIII. fig. 1.

As regards the former, it will be seen that, both in respect of the dental and the vertebral formula, it comes nearer to *T. abusalam* of the Red Sea than to any of the others; and indeed it would take very little (the loss of one tooth a side, which occurs in one instance, the transference of a dorsal vertebra to the lumbar series, and the addition of a caudal vertebra) to make the two identical in these respects. On the other hand, *T. abusalam* is said to have the pterygoids in contact, or, at all events, it is not stated to differ in this respect from *T. tursio*, but I do not attach much importance to this.

The colouring of the type, and apparently only known, specimen of *T. abusalam* is given as follows in the original description:—"Upper surface of the head and body, the tail and fins, dark sea-green. Margin of the upper lip, and entire under surface of the body to the anus whitish flesh-colour; belly with small, irregularly distributed, dark green spots. Iris dark green."

With the exception that there appears to be no white margin to the upper lip in the Indian specimen, this description accords well with the general colour of the former (especially when dried). On the other hand, the Indian specimen shows no spots on the belly (which may be a character of immaturity), and the iris is described as brown instead of green. In point of size (that is to say, in being smaller than *T. tursio*) the two agree sufficiently

well; and in both there is the same marked projection of the lower in front of the upper jaw. The more pronounced elevation of the region of the blow-hole in the type of *T. abusalam* * may probably be explained by the greater age of the specimen.

On the whole, I am inclined to regard the specimen under consideration as being the immature form of *T. abusalam*, but it may be that the absence of spotting on the belly is distinctive of the Indian form at all ages, although I do not think this probable.

With regard to the two specimens from Trevandrum figured in the 'Journal of the Bombay Society' as *T. fergusoni* and *T. catalania*, I am inclined to think that the former is the immature form of the latter †, despite the difference in the number of the dorso-lumbar vertebræ ‡. Now, if colour be worth anything in this matter (and if it be not, we have practically nothing to go upon), the type of *fergusoni* cannot be identical with the specimen here referred to *abusalam*, as both are immature specimens. Moreover, the specimens described as *fergusoni* and *catalania* differ from *abusalam* (type and young) by the general colour of the upper-parts being dark slaty instead of greenish (when the skin is dry) and in the orange tinge of the under-parts. Accordingly, if both the former belong to *catalania* (and I have practically no doubt as to the correctness of the identification of the adult), that species would appear to be distinct from *abusalam*. In addition to the difference of colour, it would seem to have fewer teeth and one caudal vertebra less.

Turning now to the specimen represented in Plate XIII. fig. 1, it might appear at first that this is the adult of the one figured in fig. 2 of the same Plate, if we could assume the disappearance of the light under-parts with age. In the first place, there is, however, no evidence that such a change takes place in this group of Dolphins; in the second place, the specimen in fig. 1 was accompanied by a younger example which had the same coloration; and, in the third place, the adults of both *T. abusalam* and *T. catalania* have light under-parts, as is also the case with *T. tursio*.

Accordingly, it would appear that the Dolphin shown in fig. 1 of the Plate, which is certainly a *Tursiops*, is distinct from these three species. Now the only member of the genus which is wholly black, with the under-parts somewhat lightened, is *T. gilli*, of the Pacific coast of North America, described on the evidence of the skull, and only known in the flesh by "momentary observations" taken by Scammon. If this evidence be trustworthy, I cannot separate the Trevándrum specimen from *T. gilli*, so far as colour is concerned.

As regards the number of the teeth, this is less in the type mandible of *gilli*, which is immature, and also in an aged skull; and it is possible that in the one case the full number may not

* See True, Bull. U.S. Nat. Mus. no. 36, pl. ix. (1889).

† I had not the figure of *T. fergusoni* when describing *T. catalania*.

‡ Differences in the number of dorso-lumbar vertebræ in several species of Dolphin are noticed in Mr. True's memoir.

have appeared, and that in the other some may have been lost. In any case, the difference is not very great or important.

That a North-Pacific Dolphin should be met with on the coasts of India is little, if at all, more improbable than the occurrence there of an Australian form (*T. catalania*). Accordingly (till evidence to the contrary be forthcoming) I propose to regard the specimen represented in Plate XIII. fig. 1 as *T. gilli*.

If I am right in the foregoing identifications (and the difficulty of the subject is so great that every determination must be regarded as more or less provisional), we shall have the following external characters of the definable species of *Tursiops*:—

1. *Tursiops tursio*. European Seas*.
   Size large: 9 ft. 6 in.
   Upper surface blackish.
   Under-parts white and unspotted.

2. *Tursiops abusalam*. Red Sea and Indian Ocean.
   Size smaller: 7 ft. $2\frac{1}{2}$ in. (type), 6 ft. 11 in. (India).
   Upper surface dark greenish.
   Under-parts whitish and spotted with green in adult; whitish in young.

3. *Tursiops catalania*. N. Australia to Indian Ocean.
   Syn. *T. fergusoni*.
   Size about the same as last: 7 ft. 8 in. (type), 7 ft. $4\frac{1}{2}$ in. (India).
   Upper surface dark slate.
   Under-parts yellowish†, flecked with lead-colour.

4. *Tursiops gilli*. N. Pacific to Indian Ocean.
   Size, Indian specimen, 6 ft. 8 in.
   Whole surface blackish, tending to lighten slightly on the under-parts, with a tinge of reddish in Indian specimens.

Whether or no I am right in any or all of these identifications, the coloured figures of the Trevandrum specimens cannot fail to be of great value in future researches on the subject; and I venture to hope that the authorities of the Trevandrum Museum will continue their excellent practice of sketching and preserving every Dolphin that may come to hand.

EXPLANATION OF PLATE XIII.

Fig. 1. *Tursiops gilli (?)*. Adult.
2. *Tursiops abusalam (?)*. Immature.

Both specimens from the Trevandrum district.

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* Till further evidence, I should doubt the occurrence of this species in the Indian Ocean.

† In the type the under-parts are said to be whitish; if the orange tint of the Trevandrum specimens is a specific character, then the name *T. fergusoni* will be available for the Indian form.

3. The Rudd Exploration of South Africa.—II. List of Mammals from the Wakkerstroom District, South-Eastern Transvaal. By Oldfield Thomas, F.R.S., F.Z.S., and Harold Schwann, F.Z.S.*

[Received January 24, 1905.]

On a previous occasion † we described a collection of mammals made by Mr. C. H. B. Grant in British Namaqualand, on behalf of Mr. C. D. Rudd, by whom they had been presented to the National Museum.

In continuation of his scientific exploration of South Africa, Mr. Rudd has now presented to the Museum a further series of specimens obtained by the same collector at and near Wakkerstroom, S.E. Transvaal, in March, April, and May 1904.

The importance of an exploration of this region lies in its being near the north-eastern limit of South Africa proper, and on the eastern border of the Transvaal tableland, thus presenting a contrast to the neighbouring area of Zululand, which has a warmer climate and lies at a much lower elevation.

The collection is a fairly large one, and includes specimens of twenty-six species or subspecies, mostly represented by series of perfect skins, with skulls and measurements, and is a very valuable accession to the National Museum.

Two localities are represented in it—Wakkerstroom itself, at an altitude of about 1850 m.; and Zuurbron, about 20 miles to the east of Wakkerstroom, altitude 1600 m.

While this collection has been under examination, the Museum has received from Mr. R. C. Wroughton, already well known by his work in Bombay, a useful series of Mammals obtained by him at Estcourt, Natal. These have in many instances proved of value in making out the Wakkerstroom species.

1. Pipistrellus kuhlii fuscatus Thos.

♂. 746. Zuurbron.

This is the first record of any *Pipistrellus* other than *P. nanus* in South Africa.

The subspecies was described from Naivasha, British East Africa, and specimens apparently referable to it are also in the Museum collection from Nyasaland.

So far as a skin can be accurately compared with a spirit-specimen, the Zuurbron example appears to agree with the type in every respect.

* [The complete account of the new species described in this communication appears here; but since the name and preliminary diagnosis were published in the 'Abstract,' the species is distinguished by the name being underlined.—Editor.]

† P. Z. S. 1904, i. p. 171.

2. RHINOLOPHUS DENTI Thos.

2 in spirit. Zuurbron.

Hitherto known only from Kuruman.

3. RHINOLOPHUS AUGUR K. And.

♂. 1 in spirit. Zuurbron.

This specimen is referred to in Mr. Andersen's original description of the species*.

4. HIPPOSIDEROS CAFFER Sund.

4 in spirit. Zuurbron.

5. AMBLYSOMUS HOTTENTOTTUS A. Sm.

♂. 767. Zuurbron.

This specimen agrees closely with Dr. Smith's type in the British Museum.

"Apparently common. Forms runs and mounds similar to *Georychus*, but so much smaller as to make these animals very difficult to trap. The specimen sent home took nearly a whole day to dig out."—*C. H. B. G.*

6. CROCIDURA FLAVESCENS Geoff.

♀. 691, 697, 709, 711, 712 (2 in spirit). ♀. 680, 682, 688, 703. Wakkerstroom.

♂. 758. ♀. 751, 754. Zuurbron.

"Zulu name in the Transvaal 'Ngoso.' Almost exclusively nocturnal. Its favourite habitat is in the stone walls surrounding the farm lands; it is common also in gardens and the thick undergrowth in the bush."—*C. H. B. G.*

7. MYOSOREX VARIUS Smuts.

♂. 747, 753. ♀. 749, 750, 757, 763, 769, 773. Zuurbron.
♂. 716, 741. ♀. 742 (2 in spirit). Wakkerstroom.

Flesh measurements of an adult male:—Head and body 85 mm.; tail 43; hind foot 14; ear 9.

On laying out the fine series of *Myosorex*† obtained from different localities in South Africa during the Rudd Exploration, we find there are two very distinct species, of which one, the true *M. varius*, is the smaller, grey in colour, with light-coloured feet, and with a comparatively short, well-haired tail, which is brown along the top and light on the sides and below. This species, besides the localities recorded by Sclater, has been found by Mr. Grant at Port Nolloth, in the North-west, Cape Peninsula

* Ann. Mag. N. H. (7) xiv. p. 380 (1904).

† 46 specimens from the Rudd collection, added to half a dozen old Museum specimens, and seven recently obtained at Estcourt, Natal, by Mr. R. C. Wroughton.

(Tokai Retreat and Table Mountains), Zuurbron and Wakkerstroom of the present series, and at Sibudeni and Umvolosi in Zululand, where it is found side by side with the larger species next to be described.

None of the collections made in the central parts of the Colony have contained any *Myosorex*, so that the genus would seem to be confined to the coast districts from Little Namaqualand round to Zululand, and corresponding to the West Cape and East Cape subregions of Dr. Matschie's zoological subdivision of Africa.

Sundevall's "*Sorex cafer*" * is clearly *M. varius*, as is shown by its short tail, and by some measurements of the typical skull kindly furnished us by Dr. Einar Lönnberg.

"Zulu name in Transvaal 'Ngoso.' Not common on the high veldt, but very plentiful on the low ground under fallen trees and in the thick vegetation near the bush. Both nocturnal and diurnal."—*C. H. B. G.*

8. MYOSOREX TENUIS, sp. n.

♀. 773. Zuurbron. *Type* of species.

This specimen being an isolated one, we have first described an allied species on a series obtained later by Mr. Grant in Zululand, as follows:—

MYOSOREX SCLATERI Thos. & Schw.

Myosorex scluteri, Thos. & Schw. Abstr. P. Z. S. No. 15, p. 10, Feb. 28, 1905.

Size considerably larger than in *M. varius* and tail longer. General colour much darker, a warm dark bistre-brown, very different to the grey of *M. varius*; approaching black in some specimens. Under surface but little lighter than upper. Upper side of hands and feet brown. Tail longer than in *M. varius*, its hairs closely adpressed and not forming a pencil at the tip, so that it looks to the naked eye much less hairy than in the allied species; its colour uniformly brown above and below, or the lower side very inconspicuously lighter.

Skull decidedly larger than in *M. varius*; the teeth similar except that i^1 is longer, its main cusp surpassing considerably in downward projection the tip of i^2, while in *M. varius* it is barely longer than that tooth. [This character is not always available for distinguishing the species, partly owing to the influence of sex, the male having generally a longer i^1 than the female, and partly to age, the tooth being occasionally so worn down as to be useless for the purpose.]

Dimensions of the type (measured in the flesh):—

Head and body 99 mm.; tail 53; hind foot 16; ear 10·5.

Skull—back of condyle to front face of i^1 25·2; basal length 22;

* Œfv. K. Vet.-Ak. Förh. 1846, p. 119.

greatest breadth across brain-case 12·5; length of upper tooth-series 10·5.

Hab. Zululand. Type from the Ngoye Hills; alt. 250 m.

Type. ♂. B.M. No. 4.12.3.12. Original number 887. Captured 28 September, 1904. Seventeen specimens examined.

We have named this well-marked species in honour of Mr. W. L. Sclater, the Director of the South African Museum, to whose kindness Mr. Grant has been very materially indebted for assistance in carrying out Mr. Rudd's exploration of East Africa.

Returning now to the specimen from Zuurbron, we think that it represents a small slender-footed species of *Myosorex* which may be briefly described as follows:—

MYOSOREX TENUIS, sp. n.

Colours and length of tail as in *M. sclateri*, but size about as in *M. varius*; the feet small and slender; tail close-haired and dark-coloured as in the Zululand form. Skull small, narrow. I^1 not particularly lengthened in the type, which, however, is a female.

Dimensions of the type (measured in the flesh):—

Head and body 76 mm.; tail 45; hind foot 14; ear 9.

Skull—back of condyle to front face of i^1 21·7; basal length 19; greatest breadth across brain-case 10·2; length of upper tooth-series 9·5.

Hab. Zuurbron, Wakkerstroom Highlands; alt. 1600 m.

Type. Female. B.M. No. 4.9.1.22. Original number 773. Collected 15 May, 1904.

9. FELIS OCREATA CAFRA Desm.

♂. 784. ♀. 776. Zuurbron.

These specimens are a trifle lighter in general colour than those from Deelfontein referred by Schwann to *F. o. cafra* *, but there is not sufficient difference to warrant their separation.

"Apparently common, but very wary. Mostly inhabiting the thick bush and sleeping in hollow trees. It, however, visits the open country at night in search of food, when it is not difficult to trap. Food consists of beetles, mice, &c. Is very destructive to poultry, visiting the same roost night after night, finally completely clearing it, if not stopped."—*C. H. B. G.*

10. CYNICTIS PENICILLATA Cuv.

♂. 729. ♀. 694, 728. Wakkerstroom.

"Zulu name in Transvaal 'Pipi.'

"Found on the high veldt, where it digs single holes, which serve as a protection when suddenly disturbed. Its food is apparently

* Ann. Mag. N. H. (7) xiii. p. 425 (1904).

insects, with mice and small birds occasionally. Diurnal only."—*C. H. B. G.*

11. SURICATA SURICATTA HAMILTONI, subsp. n.

♂. 733. Wakkerstroom.

On laying out the Museum series of Suricate skins for comparison with Mr. Grant's specimen, it is at once apparent that they fall naturally into four distinct groups or local races, as follows:—

1. Central (typical). Cape and Deelfontein.
2. South-easterly. Grahamstown.
3. North-easterly. Orange River Colony and Southern Transvaal.
4. North-westerly. Little Namaqualand (Klipfontein).

It is possible that sufficient modern material might show that the Suricate of the neighbourhood of Cape Town was subspecifically distinct from all these groups, but our only authentic Cape specimen, which was collected by General Hardwicke before 1835, is now so worn and faded that it is impossible to separate it from the Deelfontein form.

This being the case, the latter may be referred with the Cape one to the typical subspecies.

The synonymy of this typical subspecies will contain all the names hitherto published, owing to the type locality having been in each case given as "South Africa," without further details.

As represented by the specimens from Deelfontein, the typical subspecies is characterised by having the head and shoulders "drab-gray" and the cheeks and under parts of the neck dirty white. The tail appears to be rather more fulvous than in the other forms.

The other races may be described as follows:—

S. S. LOPHURUS, subsp. nov.

Under this name we distinguish a South-eastern race, represented by two specimens from Grahamstown remarkable for their large size. In colour they most resemble the series from Deelfontein, being drab-grey on the head and shoulders and dirty white or grey on the cheeks and throat. The tail is distinctly bushy and of the same general colour as the body, not showing the yellow or fulvous suffusion toward the tip so generally present in the other groups. The lengths of the hind feet are 69 and 72 mm. in the young and adult specimens respectively, as against a maximum of 67 in other members of this species in the collection.

The skull is characterised by the marked backward divergence of the zygomata and its general large size.

The younger of the two specimens, No. 97.11.5.11, still retains the rounded appearance and open basilar suture indicative of youth, but nevertheless measures 69 mm. in greatest length as against the 68 mm. of the oldest male specimen from any other locality.

Dimensions of the type (measured in the skin):—

Head and body (c.) 340 mm.; tail 200; hind foot 72; ear 18.

Skull—basal length 61 mm.; greatest length 72; zygomatic breadth 50; brain-case breadth 33.

Hab. Near Grahamstown, Cape Colony.

Type. ♂. B.M. No. 97.11.5.10. Presented by the Albany Museum.

S. s. HAMILTONI, subsp. nov.

This subspecies is based on specimens collected by Capt. G. E. H. Barrett-Hamilton at Vredefort Road, Orange River Colony, and the one obtained by Mr. C. H. B. Grant at Wakkerstroom.

It is distinguished by its generally lighter colour above and below and the stronger fulvous suffusion present on the back. One of its best characters is a strongly marked white patch extending from the eye to the neck and entirely surrounding the ear. The throat is also strongly suffused with white, while it is grey in the other subspecies. These characteristics, though not very marked in single specimens, are very apparent when a series of skins is compared.

The skull differs in no way from that of the typical subspecies.

Hab. Wakkerstroom, S.E. Transvaal; alt. 1850 m.

Type. ♂. B.M. No. 4.9.1.31. Collected 8 April, 1904.

S. s. NAMAQUENSIS, subsp. nov.

Characterised by the silvery tone of the forehead, lips, cheeks, and shoulders, these parts being grey in the other subspecies. Throat grey as usual. Suffusion on the tail more yellow than fulvous, the black tip rather less strongly pronounced than in the other races.

The silvery tone of this animal falls in well with the conclusions published in our paper * on Mr. Grant's Namaqualand collection, where the paleness of the mammals generally was noticed.

Hab. Klipfontein, Namaqualand; alt. 1034 m.

Type. ♀. B.M. No. 4.2.3.4.2. Collected 13 May, 1903. Four specimens examined.

The following is a rough key to the four subspecies of *Suricata* here recognised:—

A. Greatest length of skull 68 mm. at most; hind foot less than 65 mm.; tail less bushy.
- a. Forehead and nape uniformly coloured, white cheek-patch not passing over ears.
  - a^2. Forehead, cheeks, and shoulders with a distinctly silvery tone .... *S. s. namaquensis.*
  - b^2. Forehead and shoulders "drab-grey," cheeks dirty white .... *S. suricatta.*
- b. White cheek-patch extending above ears .... *S. s. hamiltoni.*

B. Skull 69 mm. or more; hind foot more than 67 mm.; tail very bushy .... *S. s. lophurus.*

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* P. Z. S. 1904, i. p. 172.

"Zulu name in Transvaal 'Cagiti.' Found on the high veldt only; not so common as *Cynictis penicillata*, to which its habits are similar."—*C. H. B. G.*

12. HERPESTES GRACILIS PUNCTULATUS Gray.

This Mongoose may be distinguished by its generally darker colour and the much brighter suffusion on the head and shoulders from its nearest ally, *H. gracilis cauui* Smith *, which was described from Kurrichaine, Western Transvaal †. By the kindness of Dr. H. O. Forbes, Director of the Liverpool Museum, we have been enabled to examine the type of *Herpestes cauui*, and find that it agrees in every way with specimens obtained at Essex Vale in Matabililand by Mr. F. C. Selous.

"Zulu name in Transvaal 'Cagiti.' It is said by the natives to be very fond of snakes, especially the 'Mamba.' They say that when it finds the sleeping-hole of one, it digs another directly above and behind the entrance and communicating with it, and waits there for the return of the occupant, when it seizes it at the back of head and instantly despatches it."—*C. H. B. G.*

13. ICTONYX CAPENSIS Kaup.

♂. 779. Zuurbron.

♂. 696. ♀. 695, 721. Wakkerstroom.

"Zulu name in Transvaal 'Iqaqa.' Found and trapped in the clumps of rocks on the hillsides and under the krantzes. Very destructive to poultry and occasionally eating carrion."—*C. H. B. G.*

14. TATERA BRANTSII Smith.

♂. 692, 701, 710. ♀. 699. Wakkerstroom.

The typical locality of Smith's *Gerbillus brantsii* ‡ was the "hills towards the sources of the Caledon River," that is to say along the Basuto border of the Orange River Colony.

"Not common, nor observed in the low veldt, but seems to favour lands that have at one time been under cultivation. Apparently lives in pairs with the young in small burrows of five or six holes. Nocturnal only and a vegetarian."—*C. H. B. G.*

15. OTOMYS IRRORATUS Brants.

♀. 723, 724 (1 in spirit). Wakkerstroom.

♂. 775, 782. ♀. 760. Zuurbron.

"Zulu name in Transvaal 'Ibuusi.' Partial to vleis, sluits, and all damp places where sufficient cover exists, also found occasionally in a clump of rocks some little distance from any water and in farm lands.

* Report of Expedition, p. 42 (1836).

† 25′ 40″ S., 27′ 10″ E.

‡ Report of Expedition, p. 43 (1836).

"This rat builds a dome-shaped nest of dry grass at the foot of some bush, where it both sleeps and breeds. It does not seem to burrow. Their nests and runs can be easily seen when the veldt has been burnt off. Apparently diurnal only."—*C. H. B. G.*

16. Mus colonus Brants.

♂. 768 (1 in spirit). ♀. 762, 766, 772. Zuurbron.
♂. 681 (1 in spirit). ♀. 735. Wakkerstroom.
"Not common. Seems partial to outbuildings and stone walls."—*C. H. B. G.*

17. Leggada minutoides Smith.

♂. 698, 702 (1 in spirit). ♀. 714, 715. Wakkerstroom.
♀. 781. Zuurbron.
"Zulu name in Transvaal 'Ngoso.' Not very common, inhabiting the stone walls of the lands and kraals, and the clumps of rocks and bushes on the hillsides and flats close to the bush.
"Exclusively nocturnal."—*C. H. B. G.*

18. Arvicanthis pumilio Sparrm.

♂. 755, 756 764. Zuurbron.
♂. 683, 736, 740. ♀. 686, 704, 717, 726 (1 in spirit). Wakkerstroom.
"Very common, inhabiting the outbuildings and stone walls and grass-lands."—*C. H. B. G.*

19. Dendromus mesomelas Brants.

Dendromus A. Smith, Zool. Journ. iv. pp. 438–439 (1829).
Dendromys Smuts, Enum. Mamm. Cap. 32 (1832).

♀. 765. Zuurbron.

This species was described by Brants as being red-brown on the back, with a black stripe down the median line, with which particulars Mr. Grant's specimen agrees very well, although it happens to be in rather poor fur.
"Zulu name in Transvaal, 'Ngoso.'
"It is hard to ascertain whether the two species obtained are common or not, as they are very difficult to secure, and it is impossible to learn about them from the natives, as they use the same name for so many animals. It cannot apparently be trapped, and is probably nocturnal. Dilligent search was made for nests or other signs, but none were observed."—*C. H. B. G.*

20. Dendromus melanotis Smith.

♀. 727. Wakkerstroom.

Hitherto the British Museum possessed only one example of this species, the type described by Dr. Smith in 1834, so that Mr. Grant's specimen is a very welcome addition.

D. melanotis is easily distinguished from *D. mesomelas* by its grey colour and by the peculiar structure of its hind toes, first noticed by Sclater in his 'Fauna of South Africa' *.

21. Mystromys albicaudatus fumosus, subsp. nov.

♂. 685, 705. Wakkerstroom.

Similar to the typical subspecies, but larger and darker.

General colour of the upper surface "mouse-grey" freely pencilled with black, flanks rather lighter. Individual hairs about 12 mm. long, basal four-fifths slate-grey, terminal fifth "olive-grey," tip black. General colour of under surface light grey, basal half of hairs dark slate-grey. Forehead, nape, and a ring round eyes strongly pencilled with black, lips and cheeks lighter; ears large, rounded, clothed inside with silvery hair, outside with a thick growth of very fine black hair. Fore and hind limbs slate-grey, the latter rather darker if anything; fore and hind feet white above and below; in the hind feet a naked line extends from the centre of the foot to the ankle-joint. Tail distinctly bicolor, dark grey above, pure white beneath, the line of demarcation very distinct.

The skull, though younger than that of the type of *albicaudatus*, is considerably larger.

Dimensions of the type (measured in the flesh):—

Head and body 161 mm.; tail 78; hind foot 27; ear 25.

Skull—greatest length 38 mm.; basilar length 31·5; interorbital breadth 4·5; zygomatic breadth 20·0; length of upper molar series 7.

Hab. Wakkerstroom, Transvaal; alt. 1850 m.

Type. ♂. B.M. No. 4.9.1.72. Collected 18 March, 1904.

The type of *M. albicaudatus* Smith is of a light red colour, due most probably to fading †, and we therefore do not feel justified in distinguishing from that form the grey specimens from the Orange River Colony obtained by Capt. Barrett-Hamilton.

"Not by any means common, apparently solitary and strictly nocturnal. It inhabits the stone walls of the farmlands and deserted burrows of *Gerbillus*. Cats will not eat this species, though they often kill it."—*C. H. B. G.*

22. Lepus ochropus Wagn.

♂. 707, 708, 718, 719. ♀. 730. Wakkerstroom.

These Hares, which appear to be confined to the high veldt, are easily distinguished from the low-ground *capensis* by their yellow nape and throat.

* Vol. ii. p. 32.

† While grey does not appreciably alter under the influence of light, black and brown are peculiarly susceptible to changes, and it is the black ends to the hairs which we suppose to have faded in the type. (*Cf.* 'Zoologist,' 1896, p. 406.)

Capt. G. E. Barrett-Hamilton obtained specimens at Vredefort Road, in the Orange River Colony, that agree well with Mr. Grant's skins.

"Zulu name in Transvaal 'Gwaja.'

"Common. Found only on the high rolling veldt, devoid of stones. It makes a form under a tuft of grass in which it lies very close, often rising from under one's feet. In wet weather it will not lie down, but remains sitting up in the form. It appears to feed during the night only."—*C. H. B. G.*

23. Lepus saxatilis Cuv.

♀. 725. Wakkerstroom.
♀. 777. Zuurbron.

An examination of the incisors of *L. saxatilis* shows that the extra fine line of enamel described by Thomas in *L. angolensis* * also occurs in this Hare.

24. Pronolagus †, sp.

♂. 770, 783. Zuurbron.

We are hoping to obtain specimens from the original locality of *P. crassicaudatus curryi* Thos., of which the typical skin is in very bad condition. Pending their arrival we do not propose to express any opinion about the Zuurbron Rabbit.

"Zulu name in Transvaal 'Ntenash.'

"Common, but difficult to secure owing to its lying very close. It inhabits all rocky places, both flats, krantzes, and kopjes. Feeds at night only."—*C. H. B. G.*

25. Procavia capensis Pall.

♂. 744. Zuurbron.
♂. 706, 732, 737, 738. ♀. 700, 720, 731, 739. Wakkerstroom.

"Zulu name in Transvaal 'Imbile.'

"Common. Inhabits the krantzes and rocks on the steep mountain-sides, and the rocks on the deep gullies thickly overgrown with vegetation. In this district there appear to be two forms, one distinctly redder than the other, which can easily be distinguished in the wild state. These colours are perhaps only due to seasonal changes of pelage. Strictly a vegetable feeder, often visiting the Kaffir lands and doing great damage to the pumpkins.

"Exclusively diurnal."—*C. H. B. G.*

26. Cephalophus grimmi Linn.

♀. 780. Zuurbron.

"Zulu name in Transvaal 'Mpuusi.'"—*C. H. B. G.*

* Ann. Mag. N. H. (7) xiii. p. 420 (1904).
† Lyon, "Classification of Hares," Smiths. Misc. Coll. vol. xlv. p. 332 (1904).

4. On the Greater Kudu of Somaliland.

By R. I. Pocock, Superintendent of the Gardens.

[Received February 7, 1905.]

In 1891* Major Inverarity, I.M.S., pointed out that the Greater Kudus of Somaliland differ from the typical S.-African form in the smaller number of white stripes upon the body and hind-quarters; and his reproduced photograph of a recently killed bull shows only four stripes upon the right side of the body. This information and the evidence supplied by the much-worn skin of an Abyssinian specimen in the British Museum prompted the remark on p. 176 of the last volume of the 'Book of Antelopes,' "that the sides of the body and hind-quarters [in the Greater Kudu] are marked with white stripes which vary in number from about four in the northern forms to nine or ten in the southern." Since these lines were written I have had an opportunity of seeing three young male Somaliland examples, two of which are still living in the Zoological Gardens. The two larger were deposited by Capt. Madden in July 1904; the third and smallest was presented to the Society by Major Irvine, I.M.S., in November of the same year.

The largest of the three stands at the present time 38½ inches at the withers. The horns are 5½ inches long, show the anterior ridge, an incipient twist, and have a basal circumference of 5¾ inches. The ears are 10 inches long and 4 inches wide, their span from tip to tip, when standing at right angles to the head, being 23 inches; and the length of the face from between the horns to the tip of the nose is 10 inches. On the right side seven stripes are traceable, three close together upon the haunch and four, of which the first three are widely separated from each other, upon the body. On the left side also seven stripes are traceable; of these, however, only five are complete, two on the haunches and three on the body, the additional two being very short and cut off from the dorsal middle line.

The medium-sized specimen† has the horns about 1 inch long. The ear measures 9 inches along the back, 8½ on the inside space, and 4 inches wide. The face, from between the horns to the nose, 8½ inches. On the right side there are five stripes, on the left six (three on the haunches and three on the body).

The third and smallest specimen stands about 37 inches at the withers and the horns are mere bud-like excrescences. There are five stripes (two on the haunches and three on the body) on each side.

Thus in these three specimens the stripes vary in number from

* Journ. Bombay Nat. Hist. Soc. vi. p. 463.

† This animal is now dead, and the measurements &c. are taken from the newly stripped flat skin.

five to seven on each side; but in no case are they strongly defined, and in the example showing seven, two at least are abbreviated and only just discernible. Their whole appearance, indeed, suggests evanescence.

With these data to hand, there seems to be no cause for further delay in concluding that a difference between the Greater Kudus of the northern and southern areas of the species' range not only exists, but is sufficiently definable and constant to be accorded subspecific rank. And since the specific name was applied originally to the southern form, which as a subspecies takes a repetition of that title, a different racial name must be found for the northern. There is no need, however, to publish a new one. In the 'Book of Antelopes' the following three are cited as synonyms of *Strepsiceros capensis*, the denomination under which the species wrongly appears in that work:—

Antilope tendal Cretzschmar, Atlas to Rüppell's 'Reise im nördl. Afrika,' p. 22 (1826); Fischer, Syn. Mamm. p. 475 (1829).

Antilope chora iid. ibid.

Strepsiceros abyssinicus Fitzinger, SB. Akad. Wien, lix. pt. 1, p. 176 (1869).

About the rightful claims of the first name to stand for any kind of Kudu there is, in my opinion, great doubt. The words "*in desertis*," as applied to the habitat of *Antilope tendal*, suggest rather the Addax, a large-sized, spiral-horned denizen of the deserts of North Africa, which was probably known to the Arabs. The name *chora*, however, is not to be lightly rejected. As in the case of *A. tendal*, the animal is compared to a horse in size and the horns are said to be powerful and spirally twisted in the male and absent in the female. Moreover, the habitat, "*in montosis*," accords accurately with that of the Greater Kudus of Abyssinia and Somaliland as attested by travellers and sportsmen of more modern times. There is no other African Antelope known to which these attributes apply, the absence of the horns in the female excluding any form of Eland which might otherwise be suggested on the score of size and spirally-twisted horns.

With regard to the third name, *abyssinicus*, there is no room for doubt, for, although unaccompanied by a diagnosis, it was definitely assigned by Fitzinger to the form of *Strepsiceros* inhabiting Abyssinia, Somaliland, Senaar, Kordofan, and Bogosland; and these localities do not coincide, as a whole, with the geographical range of the Lesser Kudu, the only other member of the genus met with in North-east Africa, where it extends from Somaliland and the Galla country to the Kilima Njaro district. Since, however, the name *chora* antedates *abyssinicus* by many years, I see no escape from the conclusion that the name for the northern race of the Greater Kudu is *Strepsiceros strepsiceros chora*, with *abyssinicus* as a synonym; and in that case the trinominal title for the southern or typical race is *Strepsiceros*

strepsiceros strepsiceros, with, probably, *zambesiensis* as one of its synonyms.

In connection with the difference between the two races of the Greater Kudu, an interesting point arises for elucidation. It has been shown that the northern type is distinguished from the southern by possessing only about half as many stripes on each side of the body. But the Lesser Kudu (*S. imberbis*), which also inhabits Somaliland, has even a greater number of stripes than the southern race of the Greater Kudu—namely, twelve or thirteen on each side. Thus within the limits of the genus the greatest contrast in matter of coloration subsists between the two species inhabiting Somaliland. And those who believe that the spots and stripes of Antelopes have been primarily acquired or secondarily retained, as a means of enabling species to distinguish their own kind from others of similar or somewhat similar form inhabiting the same area, may be tempted to parade the case of these two Somaliland Kudus in support of the theory.

I have, however, elsewhere* brought together and briefly stated a considerable amount of evidence that the significance of the variegated patterns of Antelopes in general, and of the Tragelaphines in particular, is procryptic or celative—that of the Tragelaphines being very obviously correlated with the bush-life affected by the majority of the species, and its absence with a life in the desert or plains, as attested by the stripeless, dun-coloured Eland of the Kalahari and the slate-grey or fawn-coloured Nylghaie of India. In connection with the two species of Somali Kudus, I cited the published statements of such reliable authorities as Swayne and Inverarity to prove that the very beautifully marked Lesser Kudu of that country is found in thick jungle, whereas the relatively poorly adorned Greater Kudu frequents mountainous broken ground less thickly overgrown with vegetation. In confirmation of this, I am glad to be able to quote the testimony of Mr. Frederick Gillett, F.Z.S., who, without being aware of the drift of my question, told me of his own knowledge that the Greater Kudu lives in hilly or rocky country and the Lesser in the lower ground, very generally amongst the luxuriant growth along the river-banks. Thus, since the species do not associate, they furnish no case for the advocates of the theory of "recognition" marks. On the contrary, the difference of habitat, correlated with the difference in coloration, practically establishes, in the absence of any other explanation, a causal connection between the two. This being so, it may be further inferred that the similar, though less marked, differences between the northern and southern races of the Greater Kudu will be found to be associated with a corresponding difference in habitat—the southern form approaching more nearly in this respect, as also in coloration, to the Lesser Kudu. At present, however, there are not, so far

* 'Nature,' Oct. 11th, 1900, pp. 384–385.

as I am aware, a sufficient number of published data to establish the truth of this hypothesis finally. Nevertheless, Selous's * statement that the S. African Kudu, although usually partial to hilly country covered with dense thickets, is also common in the thick bush along both banks of the River Chobe, where there are no hills whatever, and Kirby's † corroboration to the effect that in the heavy belts of bush lining the rivers and watercourses these animals are as at home as in rocky bush-covered hills, are very much to the point, since they testify that the habitat of the Greater Kudu of S. Africa embraces the habitats of the two forms that occur further north in that continent. Hence, if there is any truth in the theory that the markings of these Antelopes are correlated with habitat, we should expect to find the markings of the southern form of the Greater Kudu intermediate between those of the northern form of the same species and of their smaller but more beautiful ally *Strepsiceros imberbis*; and this seems to be the case.

* P. Z. S. 1881, p. 752.
† 'Haunts of Wild Game,' p. 549.

March 7, 1905.

Dr. W. T. Blanford, C.I.E., F.R.S., Vice-President, in the Chair.

Dr. Albert A. Gray, introduced by Mr. Macleod Yearsley, F.Z.S., exhibited a series of lantern-slides made from photographs of the Membranous Labyrinth of some animals, and made the following remarks:—

While the labyrinth of the fishes has been investigated by many observers and with very satisfactory results, the structure as it appears in reptiles, amphibians, birds, and mammals has not been so exhaustively treated. This is due to the difficulties of preparing the organ. These difficulties recently have been to a certain extent removed; and I propose to describe as briefly as possible some of the features which have been discovered.

In Man there is found in many individuals an accessory ampulla, as I propose to term it, at the posterior end of the horizontal canal, in addition to the normal one at the anterior extremity. This ampulla does not seem to have any special physiological significance, since it is not supplied by a nerve, and moreover is not found in all individuals but only in four out of six. I have not found it in any of the lower animals except the Sturgeon, but it is quite probable that with more material at hand it will be found in some other animals.

The labyrinth of the Seal is remarkable on account of its size, the irregular shape of the semicircular canals, and most of all on account of the presence of otoliths of considerable dimensions.

It may be that this development of the otoliths in the Seal has some relationship to the life of the animal in the water, as it is well known that in the fish the otoliths reach a size far greater than they do in any other animal. On the other hand, it may be that the development of the otoliths, and indeed of the labyrinth as a whole, is connected in some way with the migratory habit of the Seal.

The perilymphatic spaces of the semicircular canals of the Seal are, like those of Man, of considerable size, and differ in this respect from those of the Cat and the Rabbit.

The Cat has a labyrinth typical in one respect of a large number of mammals; that is, in the almost complete absence of a definite perilymphatic space in the semicircular canals. Indeed, this space is not visible except at the corners where the ampullæ of the canals debouch from the canals themselves. The cochlea of the Cat is part of a cone sharper than that of many mammals, but not quite so sharp as that of the Guinea-pig.

The Rabbit has a labyrinth similar to that of the Cat, but the cochlea is blunter in appearance. As in the Cat, there is no perilymphatic space in the canals. The ligamentum spirale is not so well developed as in many other mammals.

In addition to the already well-known features of the labyrinth

of the bird, it has to be recorded that these animals have otoliths considerably larger than those of mammals with the exception of the Seal as noted before. They are two in number and are almost in contact. One is a flat plate, and lies in the upper and posterior portion of the vestibule; the second is round and appears to lie on the first.

Without going into the physiology of the vestibule and canals as ascertained by laboratory experiments, I would like to make a few remarks on the bearing which these structures may have upon the migrations of animals.

We know, from clinical and experimental evidence, that the semicircular canals furnish the individual with an accurate knowledge of the extent to which the head has been rotated in space, whether this has been carried out by a voluntary effort on the part of the individual or by some external agency. Now, bearing this fact in mind, it has long since occurred to me that by this means we may, in part, be able to account for that mystery which has long puzzled the naturalist: the faculty by which many animals pursue their long migrations. Almost all birds migrate, a great many fishes, and even some mammals such as the Seal. That they cannot guide themselves by the sense of sight entirely is obvious, since they may pursue their flight undeterred by the darkest night and through blinding fog. Furthermore, it is difficult to understand how fishes and seals can obtain much information by vision; and, indeed, it is clear that some other sense must be employed, though vision may undoubtedly help. The same difficulty occurs in the case of the Corn-Crake, which appears to do its migration on foot, and vision can hardly avail it very much on its journey.

But the sense of direction may be obtained by other means than by the eye, namely by the semicircular canals and the vestibule. When a particular canal of one side is injured, the animal tends to rotate in a particular direction, thus indicating that the canal in question regulates the movements of the animal in that direction.

Of course this explanation does not account for the orienting process which the bird must go through before it starts its flight, but only for the faculty it possesses of pursuing the course correctly through the night or fog without having recourse to the sense of sight. How the orienting process is carried out, I do not pretend to explain, though it may be done perhaps by observing the position of the setting sun or by the bearing of surrounding objects.

Few mammals migrate in the proper sense of the term, and even those which do appear to do so, go from place to place in quest of food. The Seal, however, is one example of a mammal which does migrate in the strict meaning of the word, returning to a circumscribed breeding-place every year in a manner similar to the bird and the fish.

Now it is rather remarkable, that of all mammals the vestibule

and canals of the Seal are most like those of the bird and the fish; this fact thus tending to support the view that I have just suggested.

In Man the faculty of directing himself by means of this sense seems to have atrophied from want of use, but even in this case it has been pointed out that in the savage state the faculty is fairly keen. Some mammals display it occasionally in a remarkable manner, as in those instances in which cats and dogs find their way home from long distances, when the sense of sight could not have availed them. The homing of pigeons seems to me to be another manifestation of the same faculty.

Mr. Henry Scherren, F.Z.S., called attention to two illustrations of a Zebra in Aldrovandus (1642) and the 'Commentarius' of Ludolphus, copies of which were in the Society's library. Although they differed so widely, the text seemed to indicate that they were intended for the same species—the Abyssinian Zebra; and with respect to the plate in Ludolphus there could, from the text, be no doubt that this was the case. A translation of the passage in the 'Historia Æthiopica,' giving the description by Tellez of this Zebra, had appeared in the 'Proceedings'* (1901, ii. p. 2). In the 'Commentarius,' p. 150, Ludolphus has brought together some references to the Abyssinian Zebra. First he quotes Philostorgius (lib. iii. ch. 2), with this Latin version:—

"Haec ipsa regio fert asinos agrestes maximos, et pelle versicolores admodum, albo nigroque colore haud parum interstinctos: sed et zonæ iis quædam sunt a spina dorsi ad latera ventremque usque demissæ, indeque divisæ, et convolvulis quibusdam inter se implicatæ, mirum quendam et peregrinum exhibent nexum et varietatem."

Gothofredus (Jacques Godefroy, 1587–1652) translated the Greek *ὄνους ἀγρίους* and the Latin *asinos agrestes* by *onagros*, as did Bochart. But the former added: "Neminem alias varietatem eorum ita describere." Ludolphus presses home the argument in this wise: If Philostorgius had meant ordinary wild asses he would have used a single Greek word.

He then refers to Rome, "whither all marvellous things are sent," quoting Martial (Epigram. xiii. 101), in which *onager* with the epithet *pulcher* occurs. It is noted that no one would rightly call a wild ass "beautiful," though the word exactly suits an Abyssinian Zebra. Virgil (Georg. iii. 409) calls these animals timid:

"Sæpe etiam cursu timidos agitabis onagros";

and in the Vulgate (Osee, viii. 9) the epithet "solitarius" is used. Ludolphus anticipated recent writers in suggesting that this Zebra had been brought to Rome; but he does not mention the hippotigris. The collection of all references to the hippotigris

* The passage is marred by a mistranslation in the English version (1682) by "J. P." The sentence, "A present of great esteem, and frequently given *to* the kings of Habessinia," misrepresents what Ludolphus wrote: "In donis Regum Habessiniæ frequens et præcipuum esse solet."

is greatly to be desired. The passage from Dion Cassius (77. 6), τίγριν καὶ ἱππότιγριν . . . φονευμένους ἐν τῷ θεάτρῳ, is quoted in Dindorf's 'Thesaurus,' and the word is thus rendered:—"Est major tigris species, similis onagro, ut ait anonymus, in cod. Augustano, cap. X." Liddell & Scott looked upon the first element as qualitative—they seem to have thought that a hippotigris was a tiger as big as a horse, not a horse-like beast with tiger-like stripes. Camelopard and leopard, which have Greek forms, do not favour their definition. One would think that "hippotigris" must have occurred in Low Latin; it is not, however, entered in Ducange or Forcellini.

One sentence in Ludolphus offers some difficulty: "Attamen caput equino aliquanto longius habent, quod hîc vidi." It is not clear whether he saw a living animal or a picture. It is not impossible that a zebra may have been sent to Rome; but Ludolphus probably refers to a picture. Aldrovandus (De Quadrup. i. 416) mentions "figura quæ in libro Romæ impresso patet," and it is certain that Father Tellez, S.J., sent home a picture of which one would like to know more.

In 1678, apparently in reply to some inquiries, Ludolphus received a letter from Emanuel Nawendorf, a native of Altenburg, then resident in Batavia. He had seen two of these wild asses, brought by an Arab envoy from the Emperor of Abyssinia to the Governor of the Dutch East India Company. This personage utilised the royal gifts in a strange way. He sent them to the Emperor of Japan, getting in return ten thousand silver taels and thirty Japanese garments.

Jean de Thévenot left Rome on his eastern journey in 1655, and after some stay in Constantinople went to Cairo, where he saw one of these zebras *:—

"Au mois d'Octobre il arrive au Caire un ambassadeur d'Éthiopie, qui avait plusieurs présents pour le Grand Seigneur, entre les autres, un âne qui avait une peau fort belle, pourvu qu'elle fût naturelle, car je n'en voudrais pas répondre, ne l'ayant point examinée; cet âne avait le raye du dos noire, et tout le reste du corps était bigarré de rayes blanches et rayes tannées alternativement, larges chacun d'un doigt, qui lui ceignaient tout le corps, sa tête était extrêmement longue et bigarrée comme le corps, les oreilles fort larges par en haut, commes celles d'un buffle, et noires, jaunes, et blanches, ses jambes bigarrées de même que le corps, non pas en longue des jambes, mais à l'entour jusqu'au bas, en façon de jarretière le tout avec tant d'ordre et de mesure qu'il n'y a point Alagia † si bien varié et proportionné, ni de peau de tigre ou de léopard si belle. Il mourut à cet ambassadeur deux ânes

* 'Relations d'un Voyage,' i. ch. lxviii. (Paris, 1664).

† The only suggestion I can offer is that this word signifies some fabric with a regular pattern [from Turk. *alaja*=spotted, streaked]. The 'Century Dictionary' has *aladja*, defined as "nearly the same as *alatcha*." Under this, one reads: "A cotton stuff made in Central Asia, dyed in the thread, and woven with white stripes on a blue ground." This has reference to E. Schuyler's "Turkestan." And in 'La Grande Encyclopédie' this entry occurs:—"Aladja (Comm.). Sorte de bourre de soie que l'on fabrique à Magnésie, et qu'on emploie surtout pour les velours d'Orient."

pareils par les chemins et il en portait les peaux pour présenter au Grand Seigneur, avec celui qui était vivant."

There is no reason to doubt that the zebra which Thévenot saw at Cairo eventually reached Constantinople. In the report sent to the Superior at Rome, Father Tellez, S.J., gives his description of the animal*:—

"Ce pays nourrit deux espèces d'animaux qui lui sont particuliers, le premier qu'ils nomment âne sauvage est de la grandeur d'une moyenne mule, de bon taille, gras, le poil couché, et qui n'a rien de l'âne que les oreilles. Il est sauvage, mais l'on l'apprivoise aisément; ceux qui sont en Éthiopie viennent dans les bois qui sont par delà le pays que possèdent aujourd'hui les Galles; la bigarrure de son poil est singulière, ce sont des bandes grises, noires tirantes sur le roux, toutes de même largeur et proportion, qui se tournent en cercles vers les flancs, et ailleurs en volutes, comme la figure vous le représentera encore mieux que le discours ne le pourrait faire."

It is perhaps allowable to suggest that the picture here referred to may have been seen by Ludolphus, and was the original of his engraving.

In continuing his story Father Tellez puts the question of the arrival of an Abyssinian zebra in Constantinople beyond the shadow of a doubt:—

"L'Empereur d'Éthiopie fit présent d'un de ces animaux au Bacha de Suaquem [Suakin] qu'un Indien acheta après de lui 2000 sequins pour le présenter au Grand Mogol. Le même Empereur en ayont encore envoyé un autre à un Bacha de Suaquem à cause qu'il avait laissé passer des Jesuites en Éthiopie, sans leur faire tort; quand il fut de retour a Constantinople, il en fit présent au Grand Seigneur, qui en fut si content qu'il donna en récompense à ce Bacha une charge bien plus grande que celle qu'il avait exercée au par avant."

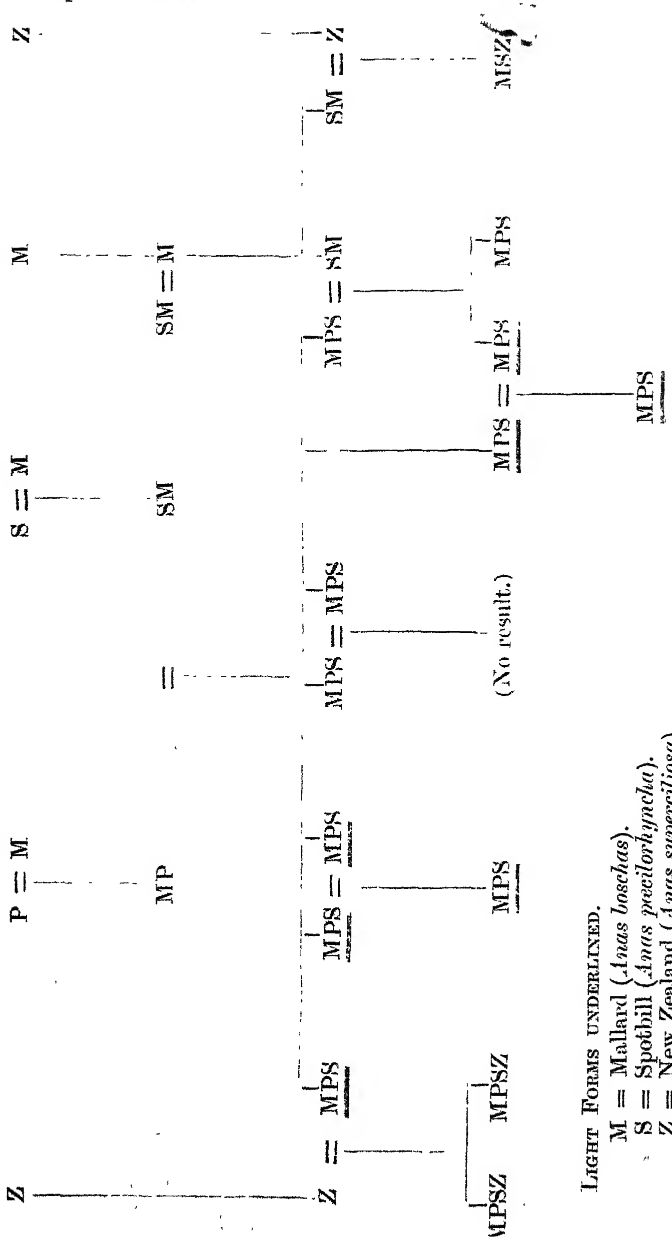
It may be pointed out that there is no question as to the habitat of this zebra, and, though there are some discrepancies in the accounts of the coloration, the authors quoted ascribe to the animal characteristics of Grévy's Zebra—large size, equine head, and very large ears; and one is definite as to the narrow striping—"a finger broad." Till the statement of Father Tellez is shown to be incorrect, are we not justified in believing that at least one living example of the Abyssinian Zebra reached Constantinople in the third quarter of the seventeenth century?

Mr. J. Lewis Bonhote, F.Z.S., exhibited specimens and made remarks with reference to a series of experiments on the hybridisation of Ducks, which he had been carrying out for several years past.

The hybrids exhibited dealt mainly with four species, viz.:— the Mallard (*Anas boschas*), the Indian Spotbill Duck (*Anas pœcilorhyncha*), the Grey or New Zealand Duck (*Anas superciliosa*), and the Pintail (*Dafila acuta*).

* Melchizedek Thévenot, 'Relations de divers Voyages,' ii. pp. 6, 7 (Paris, 1696).

The following table shows exactly the various hybrids, and examples of all of them were exhibited:—



Light Forms underlined.
M = Mallard (*Anas boschas*).
S = Spotbill (*Anas pœcilorhyncha*).
Z = New Zealand (*Anas superciliosa*).
P = Pintail (*Dafila acuta*).

Mr. Bonhote first dealt in a general way with the appearance of the various specimens, pointing out how the three parent hybrids between the Mallard, Spotbill, and Pintail tended to divide themselves into two distinct forms—a light and a dark, which differed chiefly in the amount of white.

The light forms when bred together produced birds as light or slightly lighter than themselves; a tendency which was confirmed in a still more marked manner in the third generation, so much so, that in a full-plumaged drake the only sign of its parentage was represented by the spotted bill of *A. pœcilorhyncha* and the upturned tail-coverts of the Mallard.

It was further pointed out that, as in the case of the Mallard-Spotbill hybrids*, so in the case of the Mallard-Spotbill-Pintail, the drakes in their full plumage showed chiefly signs of the Mallard and Pintail, whereas in the eclipse plumage the Spotbill was largely predominant.

Mr. Bonhote then briefly discussed some of the results obtained by hybridisation, after laying stress on the antagonism between Natural Selection and Variation, and how the one tended to keep the species pure and fixed in spite of the innate tendency of every individual to vary, and also pointing out how, in spite of Natural Selection, marked variations were constantly making their appearance among pure species—as, for instance, in the so-called *Pavo nigripennis*, or in *Athene chiaradiæ*, a peculiar form of the Little Owl (which was described from Italy a few years ago), or, again, in the well-known Sabine's Snipe.

Whatever might be the actual cause, there could be no denying the fact that hybrids tended to show a considerable amount of variation, exhibiting characteristics which might be very misleading to those who did not know their parentage.

As a rule, hybrids, while showing on most parts of their body the characteristics of their parents, exhibited in addition other markings. These last sometimes resembled the characters of other species, but in certain cases showed affinity with no known forms. Further, there was a great tendency to become white, and this last feature was ascribed to weakness, as it tended to increase in each generation that was further removed from the pure wild species.

Instances were given where, in certain characters, individual Mallard-Spotbill-Pintail showed resemblances to Teal, Gadwall, Wigeon, etc., and where Mallard-Spotbill-New Zealand crosses showed resemblances to Teal and Pintail.

Other specimens were also exhibited, showing patterns and markings that resembled no known species.

Mr. Bonhote did not believe these resemblances to be due to reversion, but merely to variation; pointing out that in all probability the progenitors of the existing Anatidæ had a potentiality of variation as great as or even greater than that of their descendants of today, and that our present species showed

* P. Z. S. 1902, vol. ii. p. 318.

those varieties which had proved successful. If by hybridisation we again gave variation its play, it would be only natural that a large number of the varieties produced should bear a resemblance to existing species; but, on the other hand, if this view held good, the unsuccessful varieties should also appear, which was shown to be the case among those individuals some of the characters of which could be referred to no known species.

Reference was made to a paper by the author*, recently read before the Linnean Society, in which he had pointed out that patches of colour or absence of colour tended to show themselves first of all on certain fixed parts of the body, on both mammals and birds, and for which the name "pœcilomeres" had been given. He then demonstrated that the variations occurring on these hybrids all followed the lines of the pœcilomeres.

As illustrating the foregoing remarks, Mr. Bonhote exhibited:

(1) A male Teal in full plumage, shot wild near Cambridge, and showing on the neck the ring of the Mallard.

(2) A Sabine's Snipe, in which the back and tail-feathers were shown to approximate to the Great Snipe rather than to the Common Snipe. This was a constant feature in all the true Sabine's Snipe that he had examined.

These were exhibited as being instances of natural varieties, showing characters more or less resembling those in other species.

A duck was also shown which had recently been shot in England, and brought to the British Museum. There could be but little doubt that it represented a cross between a Pintail and Wigeon, since the back, with the exception of the scapulars, resembled that of a Pintail, and the breast that of a young Wigeon drake. The head, however, was very peculiar, the crown showing a mixture of Pintail and Wigeon, while a patch behind the eye, resembling that found in the Teal, was of a dull metallic bronze; the sides of the face showed an irregular line of rufous buff, and the chin was dull brownish black. It was worthy of note that the metallic patch was clearly noticeable, though not so marked, in the American Wigeon; while the buff stripe across the face was found in the New-Zealand Duck.

Attention was called to a pair of Sheldrake-Call-duck crosses, which had been bred at Kilberry, as stated in the 'Field' of the 25th February, 1905, and kindly sent to the author by Mr. Campbell. Whether or not they were hybrids, Mr. Bonhote could not say; but the interest lay in the fact that all the Call-ducks there were of the colour of the wild Mallard, and that these specimens (as they could see) differed in having assumed patches of white, and these patches all followed the lines of pœcilomeres, and showed clearly that the metallic patch of the Teal, which had been present in so many of the crosses, was in this case visible, though to a much slighter extent, as a white patch.

Lastly, there was exhibited a pair of living birds representing

* Journ. Linn. Soc., Zool. xxix. p. 185 (1904).

a cross between four species, namely, the Mallard, Spotbill, Pintail, and New-Zealand Duck.

In conclusion, Mr. Bonhote said that it was far too early in his experiments to do more than quote the bare facts; but that, from the facts he had laid before them, there could be no doubt that hybridisation tended to produce variations that followed on the lines of the pœcilomeres, and that in so doing resemblances were shown towards other species that had no part in their parentage.

Mr. G. A. Boulenger, F.R.S., exhibited a series of Fishes from Lake Chad and the Shari River, collected and presented to the British Museum by Capt. G. B. Gosling, and offered the following remarks:—

The fact that so many species of fishes are common to the Nile and the Senegal-Niger, now so widely separated, has long ago led ichthyologists to assume a former communication, in times geologically recent, between these river-systems, and to regard Lake Chad as probably representing the dwindling remains of a series of lakes by which this communication was effected. But, with the exception of a series sent to the Paris Museum a few months ago and not yet reported upon in a published form, the fishes of Lake Chad and the rivers that flow into it had never been collected. Thanks to Capt. Gosling, we are now able to draw up the following list of 23 species, belonging to 7 families:—

MORMYRIDÆ. *Petrocephalus bane* Lacep., *Mormyrus caschive* Hasselq. (*jubelini* C. & V.), *Hyperopisus bebe* Lacep., *Gymnarchus niloticus* Cuv.

CHARACINIDÆ. *Hydrocyon brevis* Gthr., *Alestes baremose* Joannis, *A. dentex* L., *A. nurse* Rüpp., *Distichodus rostratus* Gthr., *D. brevipinnis* Gthr., *Citharinus citharus* Geoffr.

CYPRINIDÆ. *Labeo horie* Heck. (*senegalensis* C. & V.).

SILURIDÆ. *Clarias lazera* C. & V., *Heterobranchus senegalensis* C. & V., *Schilbe mystus* L., *Clarotes laticeps* Rüpp., *Bagrus bayad* Forsk., *Synodontis clarias* L., *S. batensoda* Rüpp., *S. serratus* Rüpp.

SERRANIDÆ. *Lates niloticus* Hasselq.

CICHLIDÆ. *Tilapia nilotica* L.

TETRODONTIDÆ. *Tetrodon fahaka* Hasselq.

All these species, without a single exception, are common to the Nile and the Niger, thus realising in a most striking manner our anticipations.

The following papers were read:—

1. A Revision of the Fishes of the South-American Cichlid Genera *Crenacara*, *Batrachops*, and *Crenicichla*. By C. Tate Regan, B.A., F.Z.S.

[Received February 7, 1905.]

(Plates XIV. & XV.*)

The genera dealt with in the following revision are distinguished from all other Cichlidæ by the denticulated posterior margin of the præoperculum. I have given a list of the specimens in the British Museum Collection on which my descriptions are based, with the total length in millimetres of each.

Crenacara.

Crenicara Steind. Sitzb. Ak. Wien, lxxi. 1875, p. 99; Eigenm. & Bray, Ann. Ac. N. York, vii. 1894, p. 619; Pellegr. Mém. Soc. Zool. France. xvi. 1903, p. 169 (1904).

Dicrossus Steind. t. c. p. 102; Eigenm. & Bray, t. c. p. 620; Pellegr. t. c. p. 170.

Body ovate or elongate, more or less compressed; scales large, ctenoid. Two lateral lines; scales of the lateral line of the same size as those above and below it. Mouth small; jaws equal anteriorly; maxillary not exposed; a band of small conical teeth in each jaw; upper surface of head scaly to between the orbits; cheeks and opercular bones scaly; posterior border of præoperculum finely denticulated. Gill-rakers short, few. A single dorsal with XIV–XVII 8–9 rays. Anal with III 7–8 rays. Pectoral asymmetrical, with 15 rays; ventrals a little behind the bases of the pectorals. Caudal rounded.

Two species from the Amazon and Guiana.

1. Crenacara punctulata.

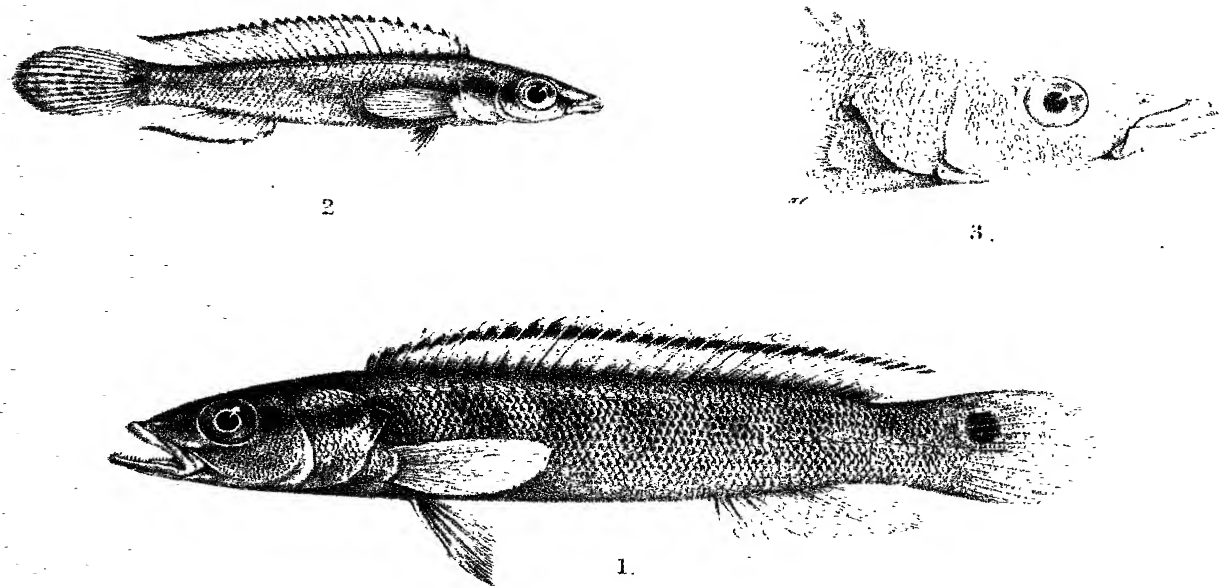
Acara punctulata (part.) Günth. Ann. Mag. Nat. Hist. xii. 1863, p. 441.

Crenicara elegans Steind. Sitzb. Ak. Wien, lxxi. 1875, p. 99, pl. i. fig. 1.

Crenicara punctulata Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 169 (1904).

Depth of body $2\frac{1}{4}$–$2\frac{2}{5}$ in the length, length of head $3\frac{1}{2}$. Snout a little shorter than eye, the diameter of which is $2\frac{3}{4}$ in the length of head and equals the interorbital width. Depth of præorbital $\frac{2}{3}$ the diameter of eye. Maxillary not extending to below the eye; jaws equal anteriorly; cheek with 3 or 4 series of scales, none on the præoperculum; 6 gill-rakers on the lower part of anterior arch. Scales 29 $\frac{3}{9}$, 1 between lateral line and

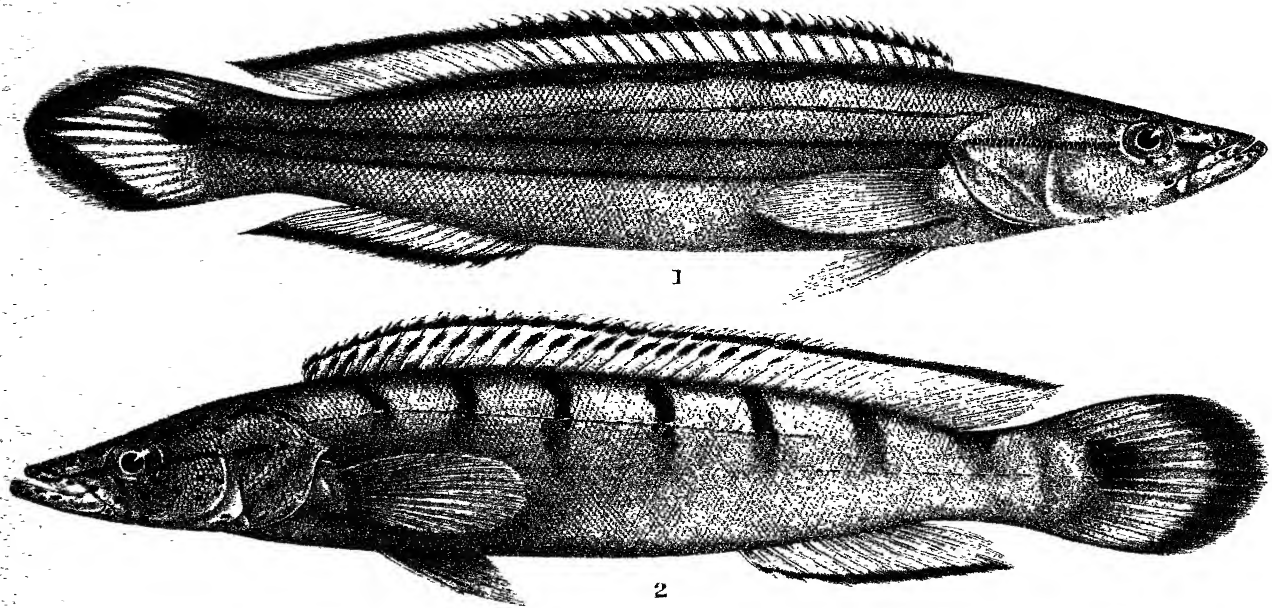
* For explanation of the Plates, see p. 168.



J. Green del. et lith.

Bale & Danielsson L^td. imp.

1. BATRACHOPS PUNCTULATUS. 2. CRENICICHLA WALLACII. 3. C. ACUTIROSTRIS.



J. Green del. et lith.

1. CRENICICHLA STRIGATA. 2. C. ORNATA.

Bale & Danielsson L.td imp.

anterior rays of soft dorsal. Dorsal XVI (XVII 8) 9, commencing above the opercular cleft, the spines not or only slightly increasing after the fifth, the last $\frac{1}{2}$–$\frac{3}{5}$ the length of head; soft fin extending to anterior $\frac{1}{4}$ of caudal. Anal III (7) 8. Soft dorsal and anal scaleless. Pectoral longer than the head; ventral extending about to origin of anal. Caudal rounded. Caudal peduncle as long as deep. Brownish, with a series of darker blotches on and above the lateral line and another more distinct series below the lateral line; a dark stripe with white edges from eye to mouth; posterior part of spinous dorsal, soft dorsal, and middle part of caudal with alternate light and dark stripes or series of spots; anal with a blackish edge.

R. Amazon; Guiana.

1. (104 mm.) type of the species.	R. Essequibo.	Mr. Ehrhardt.

2. Crenacara maculata.

Dicrossus maculatus Steind. Sitzb. Ak. Wien, lxxi. 1875, p. 102; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 170 (1904).

Depth of body $3\frac{1}{3}$–4 in the length, length of head a little more than 3. Snout shorter than eye, the diameter of which is $2\frac{2}{3}$ in the length of head and a little greater than the interorbital width. Depth of præorbital $\frac{1}{3}$ the diameter of eye. Maxillary extending to below the eye: jaws equal anteriorly; cheek with 3 series of scales, none on the præoperculum. Scales 26 $\frac{2\frac{1}{2}}{8}$, 1 between lateral line and anterior rays of soft dorsal. Dorsal XIV 9, the spines only slightly increasing after the fifth, the last more than $\frac{1}{2}$ the length of head; soft fin extending to or beyond base of caudal. Anal III 7. Pectoral as long as the head; ventral extending beyond origin of anal, sometimes to its posterior end. Caudal rounded. Caudal peduncle longer than deep. Colour as in *C. punctulata*, the body with 2 series of dark blotches, a dark stripe from eye to mouth, the vertical fins with alternate light and dark spots.

R. Amazon.

The types described by Steindachner measure up to 60 mm. in total length.

Batrachops.

Batrachops Heck. Ann. Mus. Wien, ii. 1840, p. 432.

Crenicichla (part.) Günth. Cat. Fish. iv. p. 305 (1862); Eigenm. & Bray, Ann. Ac. N. York, vii. 1894, p. 620; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 372 (1904).

Boggiania Perugia, Ann. Mus. Genova, (2) xviii. 1897, p. 148; Pellegr. t. c. p. 371.

Body elongate, little compressed; scales moderate, ctenoid. Two lateral lines; scales of the lateral line larger than the rest. Mouth moderate or large; lower jaw projecting; maxillary exposed distally; teeth conical, in 2 or 3 series in each jaw, the outermost series enlarged, especially in the lower jaw; none of

the teeth depressible. Upper surface of head usually scaly about to the level of the orbits; cheeks and opercular bones scaly; posterior border of præoperculum finely denticulated. Gill-rakers short, few. A single dorsal fin, with XXII–XXIV 10–13 rays. Anal with III 7–10 rays. Pectoral symmetrical, rounded, with about 17 rays; ventrals behind the bases of the pectorals. Caudal rounded.

Five species from South America.

Synopsis of the Species.

I. 55–60 scales in a longitudinal series below the lateral line.

Maxillary extending beyond middle of eye . . . . 1. *ocellatus.*
Maxillary extending to below anterior margin of eye . . . . . . 2. *semifasciatus.*

II. 66–70 scales in a longitudinal series below the lateral line.

A. Maxillary extending a little beyond anterior margin of eye.

Diameter of eye 4–5 in the length of head, interorbital width $2\frac{1}{2}$–3 (in specimens of from 85 to 250 mm. in total length) . . . . . . 3. *reticulatus.*
Diameter of eye $4\frac{1}{3}$ in the length of head, interorbital width $3\frac{1}{2}$ (in a specimen of 140 mm. in total length) . . . . . . 4. *punctulatus.*

B. Maxillary extending to below anterior $\frac{1}{3}$ of eye; diameter of eye $3\frac{3}{4}$ in the length of head and nearly equal to the interorbital width (in a specimen of 150 mm. in total length) . . . . . . 5. *cyanonotus.*

1. Batrachops ocellatus.

Boggiania ocellata Perugia, Ann. Mus. Genova, (2) xviii. 1897, p. 148; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 371 (1904).

Depth of body 4 in the length, length of head $3\frac{1}{4}$. Diameter of eye $5\frac{1}{2}$ in the length of head, length of snout 4, interorbital width $2\frac{1}{3}$. Nostril equidistant from eye and tip of snout. Maxillary extending nearly to below posterior margin of eye; depth of præorbital $\frac{1}{2}$ the diameter of eye. Anterior teeth forming 3 series in each jaw. 7 or 8 gill-rakers on the lower part of anterior arch. Scales feebly denticulated except on the head, the lower parts of thorax and abdomen and anteriorly above the lateral line, 74 $\frac{8}{18}$, 60 in a longitudinal series below the lateral line, 4 between last dorsal spine and lateral line, 2 between upper and lower lateral lines. Dorsal XXII 11, the spines subequal from about the eighth, the last nearly $\frac{1}{3}$ the length of head. Anal III 8. Pectoral $\frac{2}{3}$, ventral nearly $\frac{3}{5}$ the length of head. Caudal peduncle $\frac{3}{4}$ as long as deep. Olivaceous, with indistinct darker longitudinal stripes along the series of scales; a blackish ocellus on the upper part of the base of caudal.

Upper Paraguay.

Through the kindness of Dr. R. Gestro, of the Genoa Museum, I have been able to examine the type of this species, which measures 265 millimetres in total length. The posterior margin of the præoperculum is denticulated and the gill-membranes are free from the isthmus, as in other species of this genus.

2. BATRACHOPS SEMIFASCIATUS.

Batrachops semifasciatus Heck. Ann. Mus. Wien, ii. 1840, p. 436.
Crenicichla semifasciata Günth. Cat. Fish. iv. p. 309 (1862); Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 375 (1904).

Depth of body 4–5 in the length, length of head 3–$3\frac{1}{2}$. Diameter of eye $4\frac{3}{4}$–$5\frac{1}{2}$ in the length of head. Nostril nearer to tip of snout than to eye. Maxillary extending to below anterior margin of eye; depth of præorbital $\frac{1}{3}$ the diameter of eye. Anterior teeth forming about 3 series in each jaw. Scales denticulated except on the head, the lower parts of thorax and abdomen and anteriorly above the lateral line, 55–57 in a longitudinal series below the lateral line, $\frac{10}{22}$ in a transverse series. Lateral line 24–26+12–15. Dorsal XXII–XXIII 10–12. Anal III 7–10. Pectoral $\frac{2}{3}$ the length of head. Caudal peduncle about as long as deep. Scales of the sides of the body yellowish with dark brown margins; a dark stripe from eye to operculum; sometimes 7 or 8 dark cross-bars on the upper part of the body; a dark ocellus on the upper part of the base of caudal; fins unspotted.

Rio de la Plata and its tributaries.

The type, from the R. Paraguay, measures 150 mm. in total length.

3. BATRACHOPS RETICULATUS.

Batrachops reticulatus Heck. Ann. Mus. Wien, ii. 1840, p. 433.
Crenicichla reticulata Günth. Cat. Fish. iv. p. 309 (1862).
Crenicichla elegans Steind. Denkschr. Ak. Wien, xliv. 1882, p. 15; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 378 (1904).

Depth of body about 5 in the length, length of head about $3\frac{1}{3}$. Diameter of eye 4–5 in the length of head, length of snout $3\frac{1}{2}$–4, interorbital width $2\frac{1}{2}$–3. Nostril nearer to tip of snout than to eye. Maxillary extending a little beyond anterior margin of eye; depth of præorbital $\frac{3}{4}$ the diameter of eye or less. Anterior teeth forming about 3 series in each jaw. Scales denticulated except on the head, the lower parts of thorax and abdomen and anteriorly above the lateral line, 66–70 in a longitudinal series below the lateral line, $\frac{9}{22}$ in a transverse series between origin of dorsal and ventral fin. Lateral line 23–26+11–13. Dorsal XXII–XXIV 11–12, the spines subequal from the tenth, the last $\frac{1}{3}$ the length of head or less. Anal III 8. Pectoral $\frac{3}{5}$–$\frac{2}{3}$, ventral $\frac{1}{2}$–$\frac{3}{5}$ the length of head. Brownish, each scale on the side of the body with a dark brown spot at the base and a yellow margin; a dark stripe from eye to extremity of operculum; a dark ocellus on the upper part of the base of caudal; spinous dorsal with 3 longitudinal series of dark spots, which increase in number to 6 on the soft fin; anal with or without a few spots posteriorly; caudal sometimes with dark marginal bands above and below.

The type of the species, from the Rio Negro, measures about

250 mm. in total length. The types of *C. elegans*, from the Peruvian Amazon, 85 and 105 mm. respectively.

4. Batrachops punctulatus, sp. n. (Plate XIV. fig. 1.)

Crenicichla reticulata (non Heck.) Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 378 (1904).

Depth of body $5\frac{3}{5}$ in the length, length of head $3\frac{1}{3}$. Diameter of eye $4\frac{1}{4}$ in the length of head, length of snout $3\frac{1}{3}$, interorbital width $3\frac{1}{2}$. Nostril nearer to tip of snout than to eye. Maxillary extending a little beyond anterior margin of eye; depth of præorbital $\frac{1}{2}$ the diameter of eye. Anterior teeth forming 3 series in each jaw. 9 gill-rakers on the lower part of anterior arch. Scales denticulated except on the head, the lower parts of thorax and abdomen and anteriorly above the lateral line, $80\frac{11}{24}$, 68 in a longitudinal series below the lateral line, 4 or 5 between last dorsal spine and lateral line, 3 between upper and lower lateral lines. Dorsal XXIII (XXIV 11–12) 13, the spines subequal from the tenth, the last nearly $\frac{2}{5}$ the length of head. Anal III (7) 8. Pectoral nearly $\frac{2}{3}$, ventral more than $\frac{1}{2}$ the length of head. Caudal peduncle as long as deep. Brownish, each scale with a dark spot at the base; a dark band from eye to operculum, ending in a spot above the pectoral; traces of cross-bars on the body; a blackish ocellated spot on the upper part of the base of caudal; dorsal with a blackish intramarginal band.

Guiana, R. Amazon.

1. (140 mm.) type of the species.	R. Essequibo.	Mr. Ehrhardt.

5. Batrachops cyanonotus.

Crenicichla cyanonotus Cope, Proc. Am. Phil. Soc. xi. 1871, p. 569; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 378 (1904).

Depth of body about $5\frac{1}{2}$ in the length, length of head about $3\frac{1}{3}$ ($6\frac{1}{4}$ and 4 respectively in the total length, with caudal). Snout as long as the eye, the diameter of which is $3\frac{3}{4}$ in the length of head and nearly equal to the interorbital width. Maxillary extending to below anterior $\frac{1}{3}$ of eye. 66 scales in a longitudinal series below the lateral line, 5 in a transverse series above the lateral line (? at about the middle of the spinous dorsal), 13 between lateral line and the ventral fin. Dorsal XXIV 11. Anal III 8. Olivaceous; 7 oblique dark cross-bars on the body; a dark stripe from eye to extremity of operculum; a dark ocellus on the upper part of the base of caudal; dorsal and anal fins unspotted, blue at the base.

The type, from the R. Maranon, Upper Amazon, measures 150 mm. in total length.

Crenicichla.

Crenicichla Heck. Ann. Mus. Wien, ii. 1840, p. 416.

Crenicichla (part.) Günth. Cat. Fish. iv. p. 305 (1862); Eigenm. & Bray, Ann. Ac. N. York, vii. 1894, p. 620; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 372 (1904).

Body oblong or elongate, more or less compressed; scales small

or moderate, ctenoid or cycloid. Two lateral lines; scales of the lateral lines larger than the rest. Mouth moderate or large; lower jaw projecting; maxillary exposed distally; teeth conical, in several series in each jaw, those of the outermost series usually slightly or moderately enlarged; teeth of the inner series depressible. Upper surface of head scaly about to the level of the orbits; cheeks and opercular bones scaly; posterior border of præoperculum finely denticulated. Gill-rakers short, few (8–12 on the lower part of anterior arch). A single dorsal fin, with XVI–XXV 11–19 rays. Anal with III 7–12 rays. Pectoral symmetrical, rounded, with 15–20 rays; ventrals behind the bases of the pectorals. Caudal rounded.

Sixteen species from South America.

Skeleton.

In *Crenicichla johanna* the skull is depressed and nearly flat above, the supraoccipital and parietal crests being almost obsolete; the former gives rise posteriorly to a rather strong backwardly directed process; a feeble transverse ridge between the orbits forms the posterior border of a broad depression for the reception of the præmaxillary processes, which are rather short and do not reach the frontals. The vertebral column consists of 23 præcaudal and 18 caudal vertebræ; parapophyses are developed on the fourth and succeeding præcaudals and are mostly strong and almost horizontal; the first three ribs are sessile, the others inserted on the parapophyses; the epipleurals, except those of the two anterior ribless vertebræ, are attached either to the ribs or to the parapophyses near the insertion of the ribs; none of the anterior vertebræ shows any trace of inferior apophyses. The pelvic bones diverge anteriorly. The lower pharyngeals are united by a straight suture and form a broad triangular piece.

In *Crenicichla saxatilis* the skeleton is essentially similar, but the cranial crests are more distinct and the longer præmaxillary processes extend to the transverse ridge on the frontals. There are 20 præcaudal and 15 caudal vertebræ.

Synopsis of the Species.

I. Scales ctenoid, at least on the side of the body below the lateral line; nostril equidistant from tip of snout and eye, or nearer the latter.

A. 38–70 scales in a longitudinal series below the lateral line.

1. Maxillary extending beyond anterior margin of eye.

38–46 scales in a longitudinal series below the lateral line; depth of body 3–4 in the length. D. XVI–XVIII 13–16. 1. *lepidota.*

50–62 scales in a longitudinal series below the lateral line; depth of body $3\frac{3}{5}$–$4\frac{2}{3}$ in the length. D. XVII–XX 13–16. 2. *saxatilis.*

65–70 scales in a longitudinal series below the lateral line; depth of body $4\frac{2}{3}$–$5\frac{1}{2}$ in the length. D. XIX–XXI 13–14. 3. *lucius.*

54–57 scales in a longitudinal series below the lateral line; depth of body 5–$5\frac{1}{2}$ in the length. D. XX–XXII 11–12. 4. *geayi.*

2. Maxillary extending to the vertical from anterior margin of eye; 63–70 scales in a longitudinal series below the lateral line.

D. XX–XXIII 12–13. A. III 8–10; diameter of eye $\frac{1}{5}$ the length of head (in a specimen of 160 mm.) .. . . 5. *lacustris.*
D. XX–XXII 10–11. A. III 7–8; diameter of eye $\frac{1}{4}$ the length of head (in a specimen of 225 mm.) . .. . 6. *macrophthalmus.*

3. Maxillary not extending to the vertical from anterior margin of eye: 57 scales in a longitudinal series below the lateral line. D. XVIII–XX 11–13. A. III 7–9 . . . . 7. *wallacii.*

B. 84–130 scales in a longitudinal series below the lateral line.

1. Maxillary not extending to below the eye: snout more than $\frac{1}{3}$ the length of head.

a. Interorbital width $4\frac{1}{2}$–5 in the length of head.

D. XXIII 13–14. A. III 9–10. 84–95 scales in a longitudinal series below the lateral line .... 8. *vittata.*
D. XXIV 14. A. III 11. 113 scales in a longitudinal series below the lateral line .... 9. *acutirostris.*

b. Interorbital width $3\frac{1}{2}$ in the length of head.

D. XXIV–XXV 13–14. A. III 9–10 .... 10. *multispinosa.*

2.* Maxillary extending to below anterior margin of eye or a little beyond; snout $\frac{1}{3}$ the length of head or less.

a. Scales above posterior part of upper lateral line ctenoid. D. XXII–XXIII 15–17. A. III 10–12.

93–108 scales in a longitudinal series below the lateral line, 14–16 between first dorsal spine and lateral line; snout $3\frac{1}{4}$–$3\frac{2}{3}$ in the length of head .... 11. *strigata.*
106–113 scales in a longitudinal series below the lateral line, 16–17 between first dorsal spine and lateral line; snout 3–$3\frac{1}{4}$ in the length of head .... 12. *lugubris.*
120 scales in a longitudinal series below the lateral line, 20 between first dorsal spine and lateral line...... .... 13. *cincta.*

b. Scales above upper lateral line all cycloid; 112–130 in a longitudinal series below the lateral line. D. XXI–XXIII 17–19. A. III 11–12.

18–20 scales between first dorsal spine and lateral line; maxillary extending a little beyond anterior margin of eye . ... 14. *ornata.*
15 or 16 scales between first dorsal spine and lateral line; maxillary extending to below anterior margin of eye ...... 15. *lenticulata.*

II. Scales cycloid, small; nostril nearer to tip of snout than to eye ... . 16. *johanna.*

1. Crenicichla lepidota.

Crenicichla lepidota Heck. Ann. Mus. Wien, ii. 1840, p. 429; Hens. Arch. f. Nat. 1870, p. 55; Steind. Sitzb. Ak. Wien, lxx. 1874, p. 520; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 372 (1904).

Depth of body 3–4 in the length, length of head 3. Diameter of eye $3\frac{1}{2}$–5 in the length of head, length of snout $3\frac{1}{2}$–4 and equal to the interorbital width. Nostril nearer to eye than to tip of snout. Maxillary extending to below anterior $\frac{1}{3}$ of eye or beyond; depth of præorbital $\frac{2}{5}$ the diameter of eye or less. Anterior teeth

* *Crenicichla brasiliensis* var. *marmorata* (Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 383, fig.) is probably a valid species belonging to this section, but is insufficiently described. D. XXIV 17. A. III 11. Scales 116 (*i. e.* below the lateral line) $\frac{14}{34}$. Yellowish; an irregular brown band at the base of the dorsal; a series of brown spots and blotches along the middle of the side. The *Perca brasiliensis* of Bloch does not resemble any known species of *Crenicichla* and may represent a young example of *Cichla temensis* Humb.

forming 4 series in the upper jaw, 3 in the lower. 10 or 11 gill-rakers on the lower part of anterior arch. Scales denticulated except on the head and the lower parts of the thorax and abdomen, 48–60 $\frac{5-7}{11-14}$, 38–46 in a longitudinal series below the lateral line, 2–$3\frac{1}{2}$ between last dorsal spine and lateral line, 2 between upper and lower lateral lines. Lateral line 21–24+7–10. Dorsal (XVI) XVII–XVIII 13–14 (15–16), the spines subequal or only slightly increasing from the sixth, the last $\frac{1}{3}$–$\frac{2}{5}$ the length of head. Anal III 8–10. Pectoral $\frac{3}{5}$–$\frac{3}{4}$, ventral $\frac{1}{2}$–$\frac{2}{3}$ the length of head. Caudal peduncle deeper than long. Brownish; a dark stripe from snout through eye to extremity of operculum, continued on the body as a longitudinal band in the young; a dark oblique stripe below the eye; a dark blotch above the pectoral; sometimes obscure cross-bars on the upper part of the body; a dark spot or ocellus on the upper half of the base of caudal; vertical fins greyish, the dorsal sometimes with a blackish edge, the soft dorsal and caudal sometimes with clear spots.

Southern Brazil; Rio de la Plata.

1.	(159 mm.)	Rio Grande do Sul.	Dr. H. von Ihering.
2.	(69 mm.)	Upper Paraguay.	Dr. A. Borelli.
3.	(75 mm.)	Carandasiñho, Matto Grosso.	Dr. A. Borelli.
4.	(162 mm.)	Paraguay.	Dr. Ternetz.

2. CRENICICHLA SAXATILIS.

Linn. Mus. Ad. Frid. p. 65, pl. xxxi. fig. 1 (1754).

Gronov. Mus. Ichth. ii. No. 185, p. 29, pl. vi. fig. 3 (1756).

Sparus saxatilis Linn. Syst. Nat. (ed. 10), p. 278 (1758).

Scarus rufescens Gronov. Zoophyl. p. 67, pl. vi. fig. 3 (1763).

Perca saxatilis Bloch, Ausl. Fische, vi. p. 79, pl. 309 (1792).

Cichla labrina Agass. in Spix, Pisc. Bras. p. 90, pl. lxii. fig. 1 (1829); Schomb. Fish. Guiana, p. 139, pl. iii. (1843).

Crenicichla saxatilis Heck. Ann. Mus. Wien, ii. 1840, p. 432; Günth. Cat. Fish. iv. p. 308 (1862); Eigenm. & Bray, Ann. Ac. N. York, vii. 1894, p. 620; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 373 (1904).

Cychla rutilans Schomb. t. c. p. 142, pl. v.

Scarus pavoninus Gronov. Cat. Fish. p. 67 (1854).

Crenicichla frenata Gill, Ann. Lyc. N. York, vi. 1858, p. 386.

Crenicichla proteus Cope, Proc. Ac. Philad. xxiii. 1872, p. 252; Pellegr. l. c.

Crenicichla proteus, var. *argynnis* Cope, l. c.

Crenicichla saxatilis, var. *semicincta* Steind. Denkschr. Ak. Wien, lix. 1892, p. 376; Pellegr. t. c. p. 374.

Crenicichla argynnis Pellegr. t. c. p. 373.

Crenicichla saxatilis, var. *albopunctata* Pellegr. t. c. p. 374.

Crenicichla vaillanti Pellegr. Bull. Mus. Paris, 1903, p. 124, and t. c. p. 376.

Depth of body $3\frac{2}{5}$–$4\frac{2}{3}$ in the length, length of head 3–$3\frac{4}{5}$.

Diameter of eye $3\frac{3}{4}$–$5\frac{1}{3}$ in the length of head, length of snout 3–$3\frac{3}{4}$, interorbital width 3–4. Nostril nearer to eye than to tip of snout. Maxillary extending to below anterior $\frac{1}{3}$ of eye; depth of præorbital $\frac{1}{3}$–$\frac{1}{2}$ the diameter of eye. Anterior teeth forming 4 or 5 series in the upper jaw, 3 or 4 in the lower. 9–11 gill-rakers on the lower part of anterior arch. Scales denticulated except on the head and the lower parts of thorax and abdomen, 60–73 $\frac{6\text{–}8}{15\text{–}19}$, 50–62 in a longitudinal series below the lateral line, 3–$4\frac{1}{2}$ between last dorsal spine and lateral line, 2 or 3 between upper and lower lateral lines. Lateral line 22–26 + 9–12. Dorsal XVII–XX 13–16, the spines subequal from about the eighth, the last $\frac{1}{3}$–$\frac{2}{5}$ the length of head. Anal III 8–10. Pectoral about $\frac{2}{3}$, ventral $\frac{1}{2}$–$\frac{3}{5}$ the length of head. Caudal peduncle $\frac{3}{4}$ to as long as deep. Olivaceous; a dark stripe from eye to extremity of operculum, sometimes continued forward on the snout, rarely edged with white above and below; often a dark spot or oblique stripe below the eye; body with or without white spots, which may be numerous and well-developed; sometimes a continuous dark longitudinal band from operculum to caudal, which may be represented by a series of blotches or by a single blotch, or sometimes an ocellated spot, above the pectoral; a dark spot, often ocellated, on the upper part of the base of caudal; dorsal and anal sometimes with a narrow dark edge; spinous dorsal sometimes with an intramarginal series of blackish spots, one on each interradial membrane; soft dorsal and caudal often with alternate series of light and dark spots.

R. Amazon; Guiana; Trinidad; Rio Grande do Sul.

1.	(133 mm.)	Brit. Guiana.	Sir R. Schomburgk.
2–4.	(99–145 mm.)	Demerara.	Dr. Hancock.
5, 6.	(89 and 103 mm.)	Brit. Guiana.	
7.	(200 mm.)		
8, 9.	(171 and 226 mm.)	Guiana.	
10, 11.	(73 and 108 mm.)	R. Cupai.	
12.	(217 mm.)	R. Essequibo.	Mr. Ehrhardt.
13–15.	(170–271 mm.)		College of Surgeons.
16–18.	(150–201 mm.)		Stuttgart Mus.
19.	(141 mm.)	Surinam.	
20–22.	(165–211 mm.)	"	Mr. Kappler.
23.	(66 mm.)	Brit. Guiana.	C. W. Cottam, Esq.
24, 25.	(154 and 205 mm.)	Berbice.	J. G. Beckford, Esq.
26.	(104 mm.)	Tabatinga.	Mus. Comp. Zool.
27.	(155 mm.)	Rio Grande do Sul.	Dr. H. von Ihering.
28.	(185 mm.)	Trinidad.	F. W. Urich, Esq.
29–35.	(153–251 mm.)	"	L. Guppy, Esq.

3. Crenicichla lucius.

Crenicichla lucius Cope, Proc. Am. Phil. Soc. xi. 1871, p. 570; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 377 (1904).

Crenicichla anthurus Cope, Proc. Ac. Philad. xxiii. 1872, p. 252, pl. x. fig. 1; Pellegr. l. c.

Depth of body $4\frac{2}{3}$–$5\frac{1}{2}$ in the length, length of head 3. Diameter of eye $4\frac{1}{2}$–6 in the length of head, length of snout $3\frac{1}{3}$–$3\frac{2}{3}$, interorbital width 4–$5\frac{1}{3}$. Nostril nearer to eye than to tip of snout. Maxillary extending to below anterior $\frac{1}{3}$ of eye; depth of

præorbital $\frac{2}{5}$–$\frac{1}{2}$ the diameter of eye. Anterior teeth forming 4 or 5 series in the upper jaw, 3 or 4 in the lower. 10 or 11 gill-rakers on the lower part of anterior arch. Scales denticulated except on the head, the lower parts of thorax and abdomen, and anteriorly above the lateral line, 75–80 $\frac{9\text{–}11}{20\text{–}24}$, 65–70 in a longitudinal series below the lateral line, $4\frac{1}{2}$–6 between last dorsal spine and lateral line, 3 between upper and lower lateral lines. Lateral line 23–24+12–13. Dorsal XIX–XXI 13–14, the spines only slightly increasing after the fifth or sixth, the last $\frac{1}{3}$ the length of head. Anal III 10. Pectoral $\frac{3}{5}$–$\frac{2}{3}$, ventral $\frac{1}{2}$–$\frac{3}{5}$ the length of head. Caudal peduncle $1\frac{1}{3}$–$1\frac{2}{5}$ as long as deep. Olivaceous, sometimes with white spots on the body; a dark stripe from snout through eye to extremity of operculum; a dark ocellus on the lateral line above the pectoral, another on the upper part of the base of caudal; soft dorsal and caudal greyish, with light spots.

Amazons of Ecuador.

1, 2. (123 and 150 mm.)	Canelos.	C. Buckley, Esq.
3. (198 mm.)	R. Zamora.	Dr. H. Festa.

4. Crenicichla geayi.

Crenicichla geayi Pellegr. Bull. Mus. Paris, 1903, p. 123, and Mém. Soc. Zool. France, xvi. 1903, p. 375, pl. vi. fig. 4 (1904).

Depth of body 5–$5\frac{1}{2}$ in the length, length of head $3\frac{1}{3}$. Diameter of eye 5 in the length of head, length of snout $3\frac{1}{3}$, interorbital width 4. Nostril nearer to eye than to tip of snout. Maxillary extending to below middle of eye; depth of præorbital $\frac{2}{5}$ the diameter of eye. Anterior teeth forming 4 series in the upper jaw, 3 in the lower. 9 or 10 gill-rakers on the lower part of anterior arch. Scales denticulated, except on the head, the lower parts of thorax and abdomen and anteriorly above the lateral line, $65\frac{8}{19}$ $\left(\frac{10}{25}\right)$, 54 (57) in a longitudinal series below the lateral line, 4 between last dorsal spine and lateral line, 2 between upper and lower lateral lines. Lateral line 24–25+10–11. Dorsal XX 12 (XXII 11), the spines only slightly increasing from the tenth, the last $\frac{1}{3}$ the length of head. Anal III (8) 9. Pectoral $\frac{3}{5}$–$\frac{2}{3}$, ventral $\frac{1}{2}$ the length of head. Caudal peduncle longer than deep. Brownish; a dark stripe from eye to extremity of operculum; sometimes a series of blotches along the middle of the side; a dark spot or ocellus on the upper part of the base of caudal.

R. Orinoco.

1. (159 mm.)	Near Bogota.	Mr. Cutter.

This specimen agrees so well with the figure of the typical example of *C. geayi* given by Pellegrin that I have no hesitation in referring it to that species. The number of fin-rays (D. XX 12 instead of XXII 11, A. III 9 instead of III 8) and of scales in a transverse series ($\frac{8}{19}$ instead of $\frac{10}{25}$), although different, fall within the limits of individual variation, whilst the presence or absence of a series of blotches on the side is of very slight importance

5. CRENICICHLA LACUSTRIS.

Cychla lacustris Casteln. Anim. Am. Sud, Poiss. p. 19, pl. viii. fig. 3 (1855).

Crenicichla lacustris Günth. Cat. Fish. iv. p. 308 (1862); Steind. Sitzb. Ak. Wien, lxx. 1874, p. 516; Cope, Proc. Am. Phil. Soc. xxxiii. 1894, p. 102; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 379 (1904).

Crenicichla punctata Hens. Arch. f. Nat. i. 1870, p. 57.

Crenicichla polysticta Hens. t. c. p. 58.

Depth of body $4\frac{2}{3}$–5 in the length, length of head 3–$3\frac{1}{4}$. Diameter of eye 4–5 in the length of head, length of snout 3–$3\frac{1}{2}$, interorbital width $4\frac{2}{3}$–$5\frac{1}{3}$. Nostril nearer to eye than to extremity of snout. Maxillary extending to below anterior margin of eye; depth of præorbital $\frac{1}{2}$–$\frac{5}{7}$ the diameter of eye. Anterior teeth forming 5 series in the upper jaw, 4 in the lower. 10 gill-rakers on the lower part of anterior arch. Scales denticulated, except on the head, the lower parts of thorax and abdomen and anteriorly above the lateral line, 80–90 $\frac{11-1}{23-26}$, 63–70 in a longitudinal series below the lateral line, 5 or 6 between last dorsal spine and lateral line, 3 or 4 between upper and lower lateral lines. Lateral line 23–26+13–14. Dorsal XXII 12 (XX–XXIII 12–13), the spines subequal from the ninth or tenth, the last $\frac{1}{3}$ the length of head. Anal III 8–9 (10). Pectoral nearly $\frac{2}{3}$ the length of head, ventral nearly $\frac{3}{5}$. Caudal peduncle $1\frac{1}{4}$–$1\frac{1}{3}$ as long as deep. Olivaceous, with numerous small dark violet spots on upper part of head and body and on the vertical fins; sometimes a dark stripe from snout through eye to extremity of operculum, continued as a series of blotches along the middle of the side; a dark spot, sometimes ocellated, on the upper part of the base of caudal.

Southern and Eastern Brazil.

1.	(169 mm.)	Porto Real, Prov. Rio Janeiro.	M. Hardy du Dréneuf.
2.	(88 mm.)	Laguna dos Patos, Rio Grande do Sul.	Dr. H. von Ihering.

6. CRENICICHLA MACROPHTHALMUS.

Crenicichla macrophthalmus Heck. Ann. Mus. Wien, ii. 1840, p. 427; Günth. Cat. Fish. iv. p. 307 (1862); Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 379 (1904).

Depth of body about $4\frac{2}{3}$ in the length, length of head 3. Diameter of eye 4 in the length of head and equal to the interorbital width. Nostril about equidistant from eye and tip of snout. Maxillary extending to below anterior margin of eye; depth of præorbital $\frac{2}{5}$ the diameter of eye. Scales denticulated, except on the head, the lower parts of thorax and abdomen and anteriorly above the lateral line, 66–70 in a longitudinal series below the lateral line, $\frac{8-9}{17-19}$ in a transverse series. Lateral line 23–25+12–13. Dorsal XX–XXII 10–11. Anal III 7–8. Pectoral $\frac{3}{5}$, ventral $\frac{1}{2}$ the length of head. Caudal peduncle a little longer than deep. Brownish; a dark stripe from eye to operculum; scales of the

lateral line white with a blackish edge; vertical fins grey, unspotted, with dark edges.

Rio Negro.

The type measures 225 mm. in total length.

7. CRENICICHLA WALLACII, sp. n. (Plate XIV. fig. 2.)

Depth of body $5\frac{1}{4}$ in the length, length of head $3\frac{1}{3}$. Snout as long as eye, the diameter of which is $3\frac{1}{2}$ in the length of head, interorbital width $4\frac{1}{3}$. Nostril a little nearer to eye than to tip of snout. Maxillary not extending to below the eye; depth of præorbital $\frac{1}{2}$ the diameter of eye. Anterior teeth forming 5 or 6 series in each jaw. 9 gill-rakers on the lower part of anterior arch. Scales denticulated, except on the head, the lower parts of thorax and abdomen and anteriorly above the lateral line, $64\frac{6}{18}$, 57 in a longitudinal series below the lateral line, 2 between last dorsal spine and lateral line, 3 between upper and lower lateral lines. Lateral line 21+10. Dorsal XX 11 (XVIII 13), the spines subequal from the ninth, the last $\frac{1}{2}$ the length of head. Anal III 7 (9). Pectoral $\frac{5}{7}$, ventral $\frac{3}{5}$ the length of head. Caudal peduncle longer than deep. Brownish; a dark stripe from snout through eye to extremity of operculum, continued faintly along the side; dorsal and anal with a blackish marginal stripe; caudal with obscure cross-bars and with a dark spot on the upper part of its base.

R. Essequibo; R. Negro.

1. (85 mm.) type of the species.	R. Essequibo.	Mr. Ehrhardt.

Dr. A. R. Wallace has made a drawing of a fish of about the same size as the one described above and evidently of the same species, which he obtained in the Rio Negro in 1851. It was a great misfortune that the magnificent collection of Fishes of the Rio Negro made by the celebrated naturalist should have been accidentally destroyed and thus lost to science. Dr. Wallace gives the number of fin-rays as D. XVIII 13. A. III 9.

8. CRENICICHLA VITTATA.

Crenicichla vittata Heck. Ann. Mus. Wien, ii. 1840, p. 417.

Depth of body $4\frac{2}{3}$–5 in the length, length of head $3\frac{1}{5}$–$3\frac{1}{4}$. Diameter of eye 5 in the length of head, length of snout $2\frac{2}{5}$, interorbital width $4\frac{1}{2}$–5. Nostril nearer to eye than to tip of snout. Maxillary not extending to below the eye; depth of præorbital $\frac{3}{4}$ the diameter of eye. Anterior teeth forming 7 or 8 series in the upper jaw, 5 or 6 in the lower. 9 or 10 gill-rakers on the lower part of anterior arch. Scales denticulated, except on the head and the lower part of thorax and abdomen, 110–120 $\frac{11\text{–}13}{24\text{–}28}$, 84–95 in a longitudinal series below the lateral line, 6 between last dorsal spine and lateral line, 4 between upper and lower lateral lines. Lateral line 27+12–14. Dorsal XXIII 13–14, the spines subequal from the sixth, the last nearly $\frac{1}{3}$ the length of head. Anal III 9 (10). Pectoral $\frac{3}{5}$, ventral more than half the length of head.

Caudal peduncle $1\frac{1}{4}$ as long as deep. Brownish; a dark longitudinal band from tip of snout through eye to extremity of caudal; upper part of body with traces of dark cross-bars; a dark oblique stripe below the eye; a dark ocellated spot on the base of the caudal, just above the lateral line; dorsal with longitudinal series of greyish spots; caudal with a dark lower margin.

R. Amazon; R. Paraguay; Eastern Brazil.

1.	(146 mm.)	R. Parana.	Mr. Salmin.
2.	(167 mm.)	Descalvados, Matto Grosso.	Dr. Ternetz.

9. CRENICICHLA ACUTIROSTRIS. (Plate XIV. fig. 3.)

Crenicichla acutirostris Günth. Cat. Fish. iv. p. 307 (1862); Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 384 (1904).

Depth of body nearly 6 in the length, length of head $3\frac{1}{2}$. Diameter of eye $5\frac{1}{2}$ in the length of head, length of snout $2\frac{3}{4}$, interorbital width $4\frac{1}{2}$. Nostril a little nearer to eye than to tip of snout. Maxillary not extending to below the eye; depth of præorbital nearly $\frac{3}{4}$ the diameter of eye. Anterior teeth forming 7 series in the upper jaw, 4 in the lower. 9 gill-rakers on the lower part of anterior arch. Scales denticulated, except on the head, the lower parts of thorax and abdomen and anteriorly above the lateral line, $125\frac{13}{32}$, 113 in a longitudinal series below the lateral line, 7 between last dorsal spine and lateral line, 5 between upper and lower lateral lines. Lateral line 26 + 14. Dorsal XXIV 14, the spines subequal from about the tenth, the last $\frac{2}{9}$ the length of head. Anal III 11. Pectoral as long as ventral, a little more than $\frac{1}{2}$ the length of head. Caudal peduncle a little longer than deep. Brownish, with 10 dark cross-bars on the upper part of the side; anal with a narrow dark edge.

River Cupai.

1. (217 mm.) type of the species. R. Cupai.

10. CRENICICHLA MULTISPINOSA.

Crenicichla multispinosa Pellegr. Bull. Mus. Paris, 1903, p. 124, and Mém. Soc. Zool. France, xvi. 1903, p. 380, pl. vi. fig. 3 (1904).

Depth of body $5\frac{1}{3}$ in the length, length of head $3\frac{2}{5}$. Diameter of eye nearly 6 in the length of the head, length of snout $2\frac{2}{3}$, interorbital width $3\frac{1}{5}$. Nostril nearer to eye than to extremity of snout. Maxillary not extending to below the eye; depth of præorbital $\frac{4}{5}$ the diameter of eye. Anterior teeth forming 8 series in the upper jaw, 4 in the lower. 10 or 11 gill-rakers on the lower part of anterior arch. Scales denticulated, except on the head, the lower parts of thorax and abdomen and above the upper lateral line, $118\frac{16}{42}$, 102 in a longitudinal series below the lateral line, 9 between last dorsal spine and lateral line, 5 between upper and lower lateral lines. Lateral line 27 + 14. Dorsal (XXIV) XXV 13 (14), the spines subequal from about the eighth, the last $\frac{1}{3}$ the length of head. Anal III 9 (10). Pectoral $\frac{3}{5}$, ventral $\frac{1}{2}$ the length of the head. Caudal peduncle a little longer than deep. Brownish, with numerous small white spots on the

posterior part of body and the caudal fin; a blackish ocellus on the upper part of the base of caudal.

Guiana.

1. (282 mm.)	Surinam.	Mr. Kappler.

11. CRENICICHLA STRIGATA. (Plate XV. fig. 1.)

Crenicichla johanna, var. *vittata* (non *C. vittata* Heck.) Günth. Cat. Fish. iv. p. 306 (1862).

Crenicichla johanna, var. *strigata* Günth. l. c.

Crenicichla brasiliensis, var. *strigata* Pellegr. Mém. Soc. Zool. France, xvi. 1903. p. 381 (1904).

? *Crenicichla brasiliensis*, var. *vittata* Pellegr. t. c. p. 383, fig.

Depth of body $4\frac{1}{2}$–$5\frac{1}{3}$ in the length, length of head $3\frac{1}{3}$–$3\frac{1}{2}$. Diameter of eye $4\frac{1}{3}$–$5\frac{1}{2}$ in the length of head, length of snout $3\frac{1}{3}$–$3\frac{2}{3}$, interorbital width $3\frac{2}{5}$–$4\frac{1}{3}$. Nostril nearly equidistant from eye and extremity of snout. Maxillary extending to below anterior margin of eye, depth of præorbital $\frac{2}{5}$–$\frac{3}{5}$ the diameter of eye. Anterior teeth forming 5–7 series in the upper jaw, 4 or 5 in the lower. About 10 gill-rakers on the lower part of anterior arch. Scales denticulated, except on the head, the lower parts of thorax and abdomen and anteriorly above the lateral line, 110–125 $\frac{14\text{–}16}{33\text{–}39}$, 93–108 in a longitudinal series below the lateral line, 9–11 between last dorsal spine and lateral line, 5 or 6 between upper and lower lateral lines. Lateral line 25–28 + 13–15. Dorsal XXII–XXIII 17, the spines subequal from the eighth, the last $\frac{1}{3}$ the length of head. Anal III 11. Pectoral $\frac{2}{3}$, ventral $\frac{1}{2}$–$\frac{3}{5}$ the length of head. Caudal peduncle as long as or longer than deep. Olivaceous, with blackish markings; a stripe from the snout through the eye to the extremity of operculum, giving rise to two which run along the middle of the side of the body and unite to form a dark spot on the base of caudal, from which a single stripe runs to the extremity of caudal; a stripe along the upper lateral line; on each side of the base of the dorsal a series of spots or rings are connected by a longitudinal stripe; upper part of head spotted; vertical fins with marginal bands. In the young the 2 stripes from operculum to caudal form the edges of a dark longitudinal band, whilst the caudal spot is indistinct.

R. Amazon.

1–4. (177–188 mm.) types of the species.	R. Capin.	
5. (108 mm.)	R. Cupai.	
6. (132 mm.)		College of Surgeons.

12. CRENICICHLA LUGUBRIS.

Crenicichla lugubris Heck. Ann. Mus. Wien, ii. 1840, p. 422.

Crenicichla funebris Heck. t. c. p. 424.

Crenicichla johanna, var. *lugubris* Günth. Cat. Fish. iv. p. 307 (1862).

Crenicichla johanna, var. *funebris* Günth. l. c.

Crenicichla brasiliensis, var. *lugubris* Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 383, fig. (1904).

Depth of body $4\frac{2}{5}$–5 in the length, length of head 3–$3\frac{1}{2}$.

Diameter of eye $4\frac{1}{2}$–$5\frac{1}{2}$ in the length of head, length of snout 3–$3\frac{1}{4}$, interorbital width $3\frac{1}{2}$–$4\frac{2}{3}$. Nostril nearly equidistant from eye and tip of snout. Maxillary extending to below anterior margin of eye; depth of præorbital $\frac{1}{2}$–$\frac{2}{3}$ the diameter of eye. Anterior teeth forming 6 or 7 series in the upper jaw, 4 or 5 in the lower. 10–12 gill-rakers on the lower part of anterior arch. Scales denticulated, except on the head, the lower parts of thorax and abdomen and anteriorly above the lateral line, 120–130 $\frac{16\text{–}17}{35\text{–}40}$, 106–113 in a longitudinal series below the lateral line, 10 or 11 between last dorsal spine and lateral line, 4–6 between upper and lower lateral lines. Lateral line 25–27 + 14–15. Dorsal XXII–XXIII 15–17, the spines subequal or only slightly increasing from about the seventh, the last $\frac{1}{3}$ the length of head. Anal III 10–12. Pectoral $\frac{3}{5}$–$\frac{2}{3}$, ventral $\frac{1}{2}$–$\frac{3}{5}$ the length of head. Caudal peduncle as long as or a little longer than deep. Brownish; a dark spot above the pectoral and another on the middle of the basal part of caudal; dorsal and anal with a dark edge and sometimes a light intramarginal band.

Brazil; Guiana; Venezuela.

1, 2.	(159 and 250 mm.)	British Guiana.	Sir R. Schomburgk.
3.	(261 mm.)	R. Capin.	
4.	(255 mm.)	R. Essequibo.	Mr. Ehrhardt.

13 *. CRENICICHLA CINCTA, sp. n.

Crenicichla brasiliensis, var. *fasciata* (non *Cychla fasciata* Schomb.) Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 383, fig. (1904).

Depth of body $4\frac{2}{5}$ in the length, length of head $3\frac{1}{5}$. Diameter of eye $4\frac{1}{2}$ in the length of head, length of snout $3\frac{1}{3}$, interorbital width $3\frac{1}{2}$. Nostril a little nearer to eye than to tip of snout. Maxillary extending to below anterior margin of eye; depth of præorbital $\frac{2}{3}$ the diameter of eye. Anterior teeth forming 7 series in the upper jaw, 4 in the lower. 10 gill-rakers on the lower part of anterior arch. Scales denticulated, except on the head, the lower part of thorax and abdomen and anteriorly above the lateral line, 152 $\frac{20}{44}$, 120 in a longitudinal series below the lateral line, 11 between last dorsal spine and lateral line, 6 between upper and lower lateral lines. Lateral line 28 + 17. Dorsal XXIII 15, the spines subequal from the tenth, the last $\frac{1}{3}$ the length of head. Anal III 12. Pectoral $\frac{3}{5}$, ventral $\frac{1}{2}$ the length of head. Caudal peduncle $1\frac{1}{4}$ as long as deep. Olivaceous, with 9 or 10 dark vertical cross-bars on the upper half of the body; a dark longitudinal stripe from eye to above the pectoral; soft dorsal with a few large dark spots; caudal brownish, with round or oval light yellowish spots and with a blackish spot on the basal part, just above the lateral line.

Marajo Island; Para.

1.	(172 mm.) type of the species.	Para.	Dr. E. A. Göldi.

* The name *fasciata* is preoccupied in this genus by the *Cychla fasciata* of Schomburgk, which I regard as a synonym of *Crenicichla johanna* Heck.

14. Crenicichla ornata, sp. n. (Plate XV. fig. 2.)

Crenicichla brasiliensis, var *lenticulata* (non *C. lenticulata* Heck.) Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 383, fig. (1904).

Depth of body $4\frac{1}{2}$ in the length, length of head $3\frac{1}{2}$. Diameter of eye 5 in the length of head, length of snout $3\frac{1}{2}$–$3\frac{2}{3}$, interorbital width $3\frac{2}{3}$–4. Nostril equidistant from eye and tip of snout. Maxillary extending to below anterior $\frac{1}{4}$ of eye; depth of præorbital $\frac{1}{2}$ the diameter of eye. Anterior teeth forming 6 or 7 series in the upper jaw, 4 or 5 in the lower. 11 gill-rakers on the lower part of anterior arch. Scales denticulated, except on the head, the lower parts of thorax and abdomen and above the upper lateral line, 135–145 $\frac{18\text{–}20}{37\text{–}41}$, 118–130 in a longitudinal series below the lateral line, 12 or 13 between last dorsal spine and lateral line, 5 between upper and lower lateral lines. Lateral line 27–28 + 14–15. Dorsal XXII–XXIII 17–19, the spines subequal or only slightly increasing from the eighth, the last $\frac{1}{3}$ the length of head. Anal III 11–12. Pectoral $\frac{2}{3}$, ventral $\frac{1}{2}$–$\frac{3}{5}$ the length of head. Caudal peduncle as long as or longer than deep. Olivaceous, with black markings; 7 or 8 cross-bars on the upper half of the body; a stripe from eye to extremity of operculum; head with numerous spots; vertical fins with broad marginal bands; a series of spots along the middle of the spinous dorsal, one on each spine; a large spot on the upper part of the base of caudal.

R. Amazon; Guiana.

1–3.	(165–175 mm.) types of the species.	Rio Negro.	Mr. J. C. Antony.

15. Crenicichla lenticulata.

Crenicichla lenticulata Heck. Ann. Mus. Wien, ii. 1840, p. 419.

Crenicichla adspersa Heck. t. c. p. 421.

Crenicichla johanna, var. *lenticulata* Günth. Cat. Fish. iv. p. 307 (1862).

Crenicichla johanna, var. *adspersa* Günth. l. c.

Crenicichla brasiliensis, var. *adspersa* Eigenm. & Bray, Ann. Ac. N. York, vii. 1894, p. 620; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 383 (1904).

Depth of body about $4\frac{2}{3}$ in the length, length of head about $3\frac{1}{2}$. Diameter of eye 6 in the length of head and 2 in its distance from tip of lower jaw. Maxillary extending to below anterior edge of eye; depth of præorbital $\frac{1}{2}$ the diameter of eye. Scales denticulated, except on the head, the lower parts of thorax and abdomen and above the upper lateral line, 112–130 in a longitudinal series below the lateral line, $\frac{15\text{–}16}{31\text{–}34}$ in a transverse series from origin of dorsal to ventral fin. Lateral line 28–29 + 15–16. Dorsal XXI–XXII 17–18. Anal III 12. Brownish; usually a series of 8 or 9 dark blotches a little above middle of the side extending from behind the operculum to base of caudal, sometimes represented only by the first blotch, above the pectoral; head and

thoracic region with numerous small blackish spots; a dark spot or ocellus on the upper half of the base of caudal; fins unspotted, the dorsal sometimes with a dark margin, the ventral with the 2 outer rays dark.

R. Amazon.

The type of the species, from the Rio Negro, measures 350 mm. in total length; that of *C. adspersa*, from the Rio Guaporé, 265 mm.

16. Crenicichla johanna.

Crenicichla johanna Heck. Ann. Mus. Wien, ii. 1840, p. 417.

Cychla fasciata Schomb. Fish. Guiana, ii. p. 141, pl. iv. (1843).

Crenicichla obtusirostris Günth. Cat. Fish. iv. p. 305 (1862).

Crenicichla johanna, var. *johanna* Günth. t. c. p. 306.

Crenicichla brasiliensis, var. *johanna* Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 383, fig. (1904).

Depth of body 4–$4\frac{2}{3}$ in the length, length of head $3\frac{1}{3}$–$3\frac{1}{2}$. Diameter of eye $4\frac{3}{4}$–$5\frac{1}{2}$ in the length of head, length of snout $3\frac{1}{3}$–$3\frac{2}{3}$, interorbital width $2\frac{2}{3}$–$3\frac{1}{2}$. Nostril much nearer to tip of snout than to eye. Maxillary extending to below anterior margin of eye; depth of præorbital $\frac{1}{2}$–$\frac{2}{3}$ the diameter of eye. Anterior teeth forming 4 or 5 series in the upper jaw, 3 or 4 in the lower. 10 or 11 gill-rakers on the lower part of anterior arch. Scales cycloid, 124–133 $\frac{16\text{–}17}{41\text{–}45}$, 97–108 in a longitudinal series below the lateral line, 10 or 11 between last dorsal spine and lateral line, 6 or 7 between upper and lower lateral lines. Lateral line 26–27 + 13–14. Dorsal XXI–XXIV 16–17, the spines subequal or only slightly increasing from about the tenth, the last $\frac{1}{3}$ the length of head. Anal III 11–12. Pectoral $\frac{3}{5}$–$\frac{2}{3}$, ventral $\frac{1}{2}$–$\frac{3}{5}$ the length of head. Caudal peduncle as long as or longer than deep. Brownish; 10 or 12 dark cross-bars above the lateral line, obscure or absent in the adult; body below the lateral line sometimes with alternate light and dark undulating vertical stripes; dorsal sometimes with a dark margin and light intra-marginal band.

Brazil; Guiana; Venezuela.

1. (260 mm.)			Zool. Soc.
2. (325 mm.)	type of *C. obtusirostris*.	R. Capin.	
3. (151 mm.)		R. Cupai.	
4. (285 mm.)		R. Capin.	Dr. E. A. Göldi.
5. Skeleton.		R. Capin.	Dr. E. A. Göldi.
6. (250 mm.)		L. Hyanuary.	Prof. A. Agassiz.

EXPLANATION OF THE PLATES.

Plate XIV.

Fig. 1. *Batrachops punctulatus*, p. 156.
2. *Crenicichla wallacii*, p. 163.
3. „ *acutirostris*, p. 164.

Plate XV.

Fig. 1. *Crenicichla strigata*, p. 165.
2. „ *ornata*, p. 167.

2. Notes on a New Oribi Antelope from the Kenya District, British East Africa. By Capt. R. Meinertzhagen, F.Z.S.

[Received February 15, 1905.]

[The complete account of the new species described in this communication appears here; but since the name and preliminary diagnosis were published in the 'Abstract,' the species is distinguished by the name being underlined.—Editor.]

The Oribi found near Mount Kenya, British East Africa, has never been satisfactorily determined, and as I obtained a considerable number of skulls, now in the British Museum, I have made a careful comparison of them with the specimens already in that collection. The species appears to be undoubtedly different both from the *Ourebia montana* of Abyssinia and the *O. haggardi* of Lamu, and I have therefore proposed for it the name of *O. kenyæ*.

Ourebia kenyæ.

Ourebia kenyæ Meinertzhagen, Abstr. P.Z.S. No. 16, p. 15 March 14, 1905.

This new Antelope seems to be most closely allied to Haggard's Oribi, of the lower waters of the Tana and the adjacent coast-line, but differs in the following respects:—

The horns are not so thick nor so roughly and irregularly ridged, and their "set" seems to differ from that found in *O. haggardi* in leaving the skull at a much more forward angle and having a tendency to a marked forward and divergent curvature.

General colour bright fulvous, corresponding as nearly as possible with the "tawny ochraceous" of Ridgway. Chin and throat white. Above the anterior portion of each eye a white streak, about half an inch broad and continuing towards the muzzle for about an inch. Ears fringed with dark brown on their upper parts. Tail about four inches long, the last three inches thickly tufted, black, the proximal portion white-edged below.

Skull. Dimensions of type specimen*:—

Basal length	145 mm.
Greatest breadth	75 "
Orbit to muzzle	84 "

Length of horn on curve 136; circumference at base 53.

The following are some measurements of males taken in the field:—

Height at shoulder.	Length.	Weight (uncleaned).	Length of horns.
inches.	inches.	lbs.	inches.
24	40½	36	5½
23	40	38	6
25	42	36	5¼
24½	41	40	5 3/16

* British Museum, No. 4.11.5.28.

The following is the measurement of a female:—

Height at shoulder.	Length.	Weight.	
inches.	inches.	lbs.	
$25\frac{1}{2}$	$43\frac{1}{2}$	36	4 teats.

Habitat. As far as is known at present the range of this Antelope is extremely limited. It is found on the upper water of the Tana River, about 50 miles due south of Mount Kenya and about 5 miles south-east of Fort Hall, where it is very plentiful. It extends only about 10 miles down the Tana River, and is not found further from the river than the Ithanga Hills and their immediate neighbourhood.

3. The Œcology and Deposits of the Cape Verde Marine Fauna. By Cyril Crossland, M.A., B.Sc., F.Z.S., Carnegie Fellow and Fellow of the University of St. Andrews.

[Received January 13, 1905.]

(Text-figures 21–26.)

Contents.

1. Introduction.

An examination of the Collections made by me for Sir Charles Eliot, K.C.M.G., in Zanzibar and East Africa in 1900–1902 showed at once that the whole Indo-Pacific Ocean from Africa to the Pacific Archipelagoes is one faunistic area. The region, however, is not so well known as to admit of definite subdivision; in East Africa, *e. g.*, we cannot say whether the numerous new species discovered are characteristic of the region or merely of the special habitats which we examined.

The wide distribution of many of the Opisthobranch Molluscs is so striking as to have led Sir Charles Eliot to suggest an expedition to the Tropical Atlantic, with the object of discovering whether there is any relationship between the faunas of these so widely separated oceans. As several species of Polychæta also appear to range from the Indo-Pacific to the Mediterranean and even Caribbean Seas, the idea was highly attractive to me. I am convinced, too, that the special difficulties of systematic work on the Polychæta can be satisfactorily attacked only by the

examination of several large collections simultaneously by a worker (or group of workers) who has seen the specimens alive.

The fauna of the Cape Verde Islands also promises to be interesting in connection with the ocean-currents of the Atlantic. The group (text-fig. 21) lies in the path of the southern division of the Gulf-stream, which is joined by another stream from near the Straits of Gibraltar. Both these are cold currents, the warm stream from the Gulf of Guinea passing a little to the south of the group. It will be interesting to know what constituents of the fauna, if any, are derived from the Caribbean Sea. Some North Atlantic and Mediterranean forms are mentioned below.

Text-fig. 21.

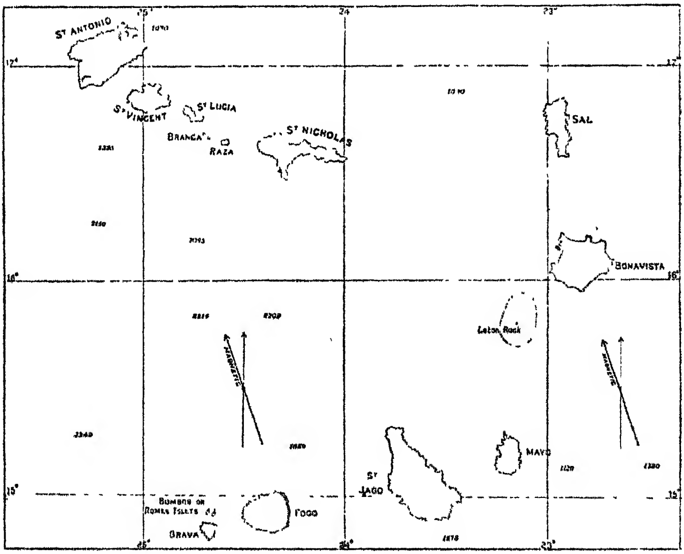


Chart of the Cape Verde Islands.

For the purpose of a comparison of faunas, the common forms of life in a few groups are sufficient, and a summer vacation affords time enough to collect these. I therefore applied to the Carnegie Trustees for funds to enable me to spend two months in the Islands, which they generously supplied. The kindness of many friends at home and in the Islands made my stay most pleasant, besides contributing much to the success of my work. I cannot publicly thank all by name, but to Messrs. Rhodes and Pacey, Managers of Messrs. Wilson's Coaling Company, I owe special gratitude for the use of a room in their house as a head-quarters' laboratory—a boon the value of which the donors themselves could hardly fully estimate.

Little previous work on the marine fauna of the Islands has been done; indeed, it was difficult to get much information of any sort about the locality*. The 'Challenger' spent nineteen days dredging in the harbour of St. Vincent with somewhat discouraging results as regards the Polychæta and Opisthobranchiata. The former appear to be unusually interesting, however, since, of the fourteen species collected, seven were new and obtained nowhere else, while three were found to be widely distributed in the North Atlantic and West Indies and others were Mediterranean †.

The Canary Islands and Madeira have been worked by Langerhans (Polychæta) and other well-known zoologists. But these Islands are well north of the Tropical zone and afford no fair comparison with the Tropics of the Indian Ocean.

2. Narrative and Results.

In approaching St. Vincent ‡ (text-fig. 22) one is immediately struck by the physical differences between the Cape Verde Islands and the coast of East Africa. In place of the low level lines of the local limestone formation, densely clothed with bush, or, at Zanzibar, with cocoanuts, cloves, and mangoes, we are here confronted with the huge mass of the Island of St. Antonio, 7000 feet in height, rising directly from the sea, with St. Vincent to the left, lower (2400 feet) but even more ragged in outline. Both islands show their volcanic origin very obviously, and their grey precipices and red slopes are utterly devoid of vegetation. The shores themselves, with which we are more directly concerned, also differ. In place of the broad shore-platform, smooth, barren, and almost quite devoid of loose stones, which is characteristic of the East-African coral-rock, we have here a shore, so narrow as to be almost invisible on the Admiralty Charts, composed of lava, and often covered with stones of all sizes, from that of a cottage downwards.

The tides rise from 3 to 5 feet at springs, according to the locality, as against 8 to 12 feet in East Africa. In partial correspondence with this the rich zone of the shore in the latter locality is from lowest tide-level down to 2 or 3 fathoms, so that, without wading, little could be done. Here also there is a well-marked rich zone, but it extends halfway up to high-water mark and ends abruptly 2 or 3 feet below the level of lowest springs. The rocks of this zone are covered by a belt of mossy green, brown, and red seaweeds and nullipores; below it they are bare or only merely painted over by nullipore and bear little else

* The most useful accounts are in the 'Universal Geography,' vols. xi. & xii., and the Admiralty Pilot Series.

† 'Challenger' Reports, Summary of Results, vol. i. pp. 303–314. The avian fauna has been collected for the British Museum by Captain Boyd Alexander, whose results are recorded in the 'Ibis,' 1898, pp. 74–118 and 277–285.

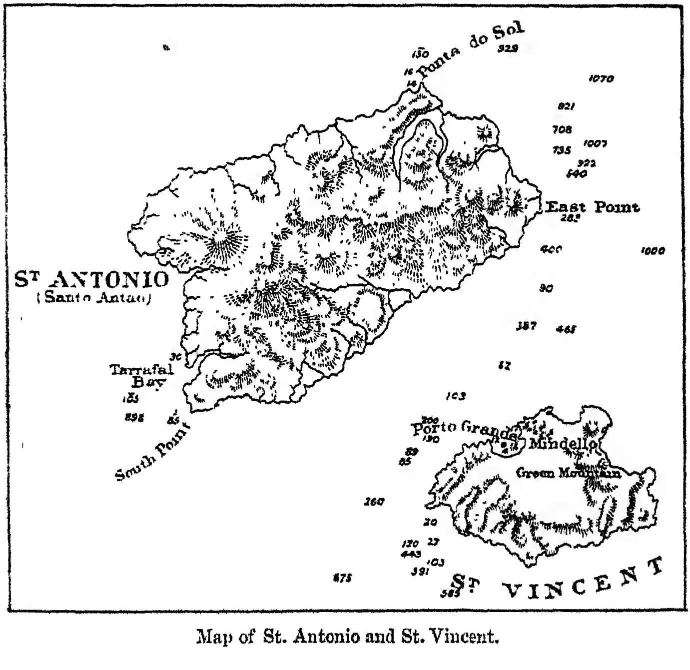
‡ Properly the Island is San Vicente, the town Mindello, and the Harbour Porto Grande. For simplicity I use St. Vincent for all three.

but a few isolated coral-colonies, comprising only three species. Wading is generally impossible on account of the steepness of the shore and the strength of the surf, which in more or less diminished strength reaches every part of the few bays.

The native fishermen use nets, traps, and lines, principally the latter, the universal bait being raw fish. Ground-bait, also raw fish, is used freely, being prepared by mastication and distributed about the lines by expectoration.

"Coral" (*Corallium rubrum*) fishing was done in the past, but is wholly abandoned now, some of the merchants attributing this to the competition of the Japanese, others to the exorbitance of the Portuguese Customs.

Text-fig. 22.



Map of St. Antonio and St. Vincent.

But at St. Vincent all these fisheries have small following in comparison with the number of boats engaged in dredging for small coal lost overboard from steamers and lighters. The largest of the native boats, small and simply rigged cutters, engage in this exclusively, using three light dredges each. However unromantic old clinkers may be as a habitat, their richness in Polyzoa, Polychæta, and small Crustacea is most beautiful, and the three largest of my Gephyreans were thus obtained.

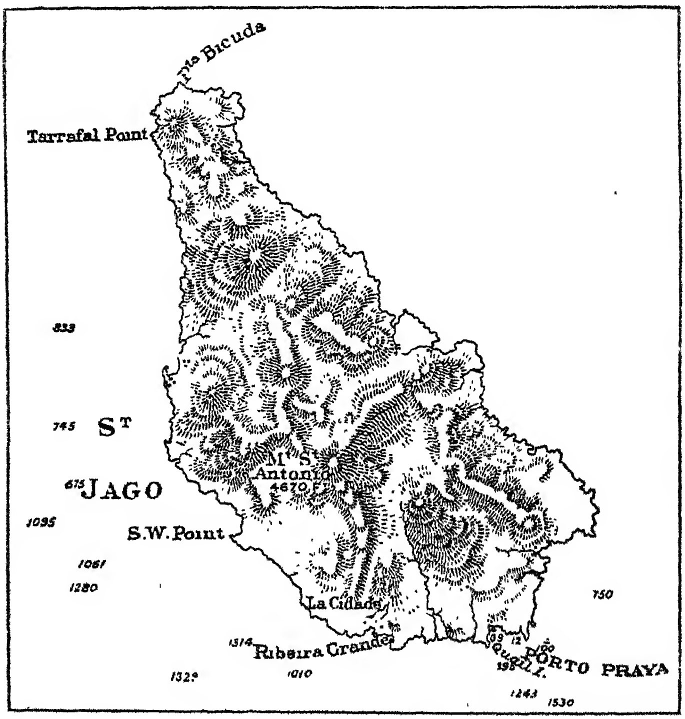
After a fortnight's very successful collecting in St. Vincent

Harbour it became evident that the fauna of these coasts is as distinct from that of East Africa as are the physical aspects and geological structure of the two localities, and that it contains a considerable northern or Mediterranean constituent. I therefore decided to visit one of the Southern Islands in the hope of discovering:—

(1) Possible effects on the fauna of the Guinea current.
(2) Fresh habitats, e. g. *Zostera*-beds or completely sheltered water.
(3) Coral, either as reef or banks, with its peculiar fauna.

A three days' voyage in a small Portuguese barque brought me to Porto Praya, a bay in the southern extremity of the Island of

Text-fig. 23.



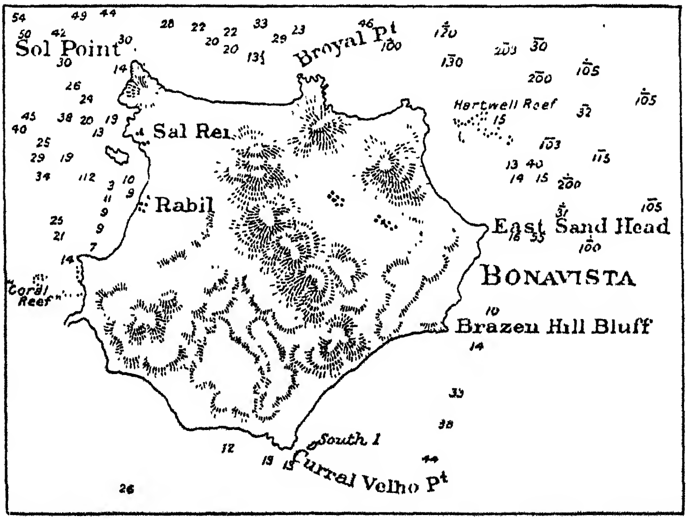
Map of St. Jago.

St. Jago (text-fig. 23), situated in latitude 16° N., just a degree south of St. Vincent. The results of collecting here were negative as regards (1) and (3) above, but a small extent of stony shore under

lee of Quail Island* is completely sheltered at all seasons and gradually slopes into the shallow channel. Consequently, this area was very rich, large holothurians being seen here for the first time, and many other fresh forms were added to the collections. At the same time, it has since become clear that the fauna is really identical from north to south, and that the Guinea current is too far away to affect any Islands of the group.

Tunny-fishing with rod and line is carried on at Praya. The boats engaged in this rather exciting work are little tubs holding two men, but which were made to carry three rowers and a passenger in my dredging-expeditions. Although it is said that a big tunny may tow a boat seven or eight miles out to sea, the

Text-fig. 24.



Map of Bonavista.

boats are very roughly constructed, leaks being discovered and roughly caulked every day. On one occasion, when I pointed out a bubbling spring in the bottom of the boat, one of the crew unconcernedly handed over a portion of his trousers with which to plug the leak!

Except for the small sheltered area afforded by Quail Island, the shores and bottom of Porto Praya are so like St. Vincent that I took the opportunity of returning there by Portuguese mail,

* This islet is memorable, since Darwin made collections on its shores during the voyage of the 'Beagle.'

after a stay of a little over a week, in order to find means of reaching the Island of Bonavista (text-fig. 24), in the east of the group, to examine some "coral-reefs" marked on the charts. This occurred three days later when the Government steamer 'Mindello' left St. Vincent for its monthly circuit of the Islands. I thus saw the northern point of St. Antonio, with its deep valleys, carpeted with vivid green, and the huge precipices of its shores, the lower but rocky shores of St. Nicholas, and the white sand-spit which forms the southern part of Sal—the Island of Salt (text-fig. 21, p. 171). This was the first time I had seen pure white sand in these islands, so suggestive of the vicinity of coral. However, neither here nor at Bonavista, where the same sand forms a large part of the western shore, is there any sand, or indeed any other rock, of coral origin, and the "coral-reefs" of the chart, like others in the vicinity, are simply limestone shoals, not resembling coral-reefs even in form and with either very little or no coral anywhere about them.

The same absence of coral-reefs has been characteristic of the past, for although the greater part of at least the western side of Bonavista is of recent limestone, containing in places numerous fossil shells, I found no particle of coral in it, either on the coast or inland, or in the small shallow limestone beds near the town of St. Vincent.

Bonavista is not an appropriate name. The appearance of the island is not at all picturesque, and its discovery has not been much blessing to the human race. The island is a desert only a little less complete than the greater part of St. Vincent. As a little grass grows after rain, a population is established on the island subsisting by cattle-breeding. Every few years the rain fails to appear, and as much as a third of the population perishes, since relief works are practically unknown to the Portuguese Government. At Port Sal Rei half the houses are in ruins, and some have even been abandoned during course of erection. Residence among such signs of misery is not pleasant, and I was glad to leave at the end of a fortnight, having satisfied myself that Coral or *Zostera* habitats do not occur in these Islands.

My return to St. Vincent involved three days in a small Italian "felua," but, in spite of the motion of so small a boat and the primitiveness of the accommodation provided (on deck), much of the time was rendered delightful by the number and variety of fish, birds, and dolphins seen close at hand during a calm.

3. Comparison of the Fauna with that of East Africa.

Although several East-African species reach the Mediterranean, and certainly others extend from this sea to the Cape Verde Islands, it is at once and certainly evident that the faunas of these two localities, taken as wholes, are distinct. Of species common to the two localities, there are at least three species of Crab, several Prosobranch molluscs, the Polychæte *Eunice*

siciliensis (which is, however, well-known to be cosmopolitan), and *Thalassema baronii*. Species already recognised as belonging to the North Atlantic and Mediterannean are as follows:—

POLYCHÆTA: *Eunice torquata* Qfg. (=*E. fasciata* Risso *), *E. siciliensis* Gr., *Staurocephalus rubrovittatus*, *Hesione sicula*, *Nereis dumerilii*, and *Phyllodoce pancerina* Clp.
NEMERTINES: *Nemertes neesii.*

Of the OPISTHOBRANCH MOLLUSCA, Sir Charles Eliot gives the following provisional identifications:—

Lophocercus olivacea.	Mediterranean.
Candiella lineata.	British.
Favorinus carneus.	,,
Philine aperta.	,,

He also remarks that "there are no big Dorids (or, rather, only one) and only one *Chromodoris*; the common Indo-Pacific forms, *Hexabranchus*, *Asteronotus*, *Bornella*, *Phyllidia*, *Dolabella*, are all absent."

Indeed, for the present, the difference is most strikingly shown by the absence from the Cape Verde fauna of groups conspicuously abundant in East Africa. Planarians, such as the highly-coloured Pseudoceridæ, so abundant in species and in individuals in the Indo-Pacific, are here practically absent. Is it merely a coincidence that the family of Opisthobranchs which is also characterised by gorgeousness of colouring, the Chromodoridæ, are here also represented by but one species?

At low spring-tide level, almost everywhere in East Africa, Alcyonarians, especially Xeniidæ and Clavulariidæ, are astonishingly abundant, in places literally carpeting the rocks. *Lobophytum*, *Sarcophytum*, *Tubipora*, &c. may be equally abundant over certain areas, while in Wasin Harbour *Telesto* and other tree-like genera filled the dredge at every haul. Similarly for the Corals. Large areas of East-African coasts are totally devoid of coral-growths, but in other parts the quantity and the number of species found between the levels of low spring-tides and five to fifteen fathoms are indescribable.

Here, in the Cape Verdes, the littoral Alcyonaria are represented by but *one* fairly common species, a Cornularian, which is found under stones. A few species of Gorgonians are found, but rarely, in water of over 18 fathoms in depth.

Of the five littoral species of Coral belonging to the genera *Siderastræa* and *Pontis*, two form incrustations only, and the colonies do not exceed six or eight inches in diameter. The largest mass met with was about nine inches thick, and covered an area of two or three square feet. Contrast the Porites cylinders of the Zanzibar reefs or the composite masses covering

* Ehlers (Nach. zu Gött. 1900) describes *E. fasciata* from a small collection from East Africa, but it does not occur in my own or in Stanley Gardiner's from the Maldives.

hundreds of square yards of the coast of Pemba and the Zanzibar Channel *.

4. The Organic Deposits.

Nullipores, on the other hand, are extremely abundant; every rock exposed to the surf is thickly coated with them, and since the coasts are nearly all rock, and the surf penetrates to every bay, the total amount is enormous.

Owing to this nature of the shores, it is impossible to land in most parts of the Islands, so that it is not easy for a worker who is necessarily confined to the few more or less sheltered bays to obtain a correct general idea of the condition of the balance of life round the coasts as a whole. I have been able to make detailed examinations of fully exposed rocks at Bird Island at the entrance to St. Vincent Harbour and in Bonavista, and have seen sufficient of other coasts to know that these examples are typical of practically the whole coast-line.

The most exposed projections of the rock on Bird Island are covered by a nullipore of a stout foliaceous kind, consisting of vertical branches connected at intervals by horizontal platforms. Between the areas occupied by this species the surface seems to be made of smooth encrusting nullipore bearing clumps of mossy green and brown weed. These form a broad belt extending from near high-tide mark to a little below the level of lowest tides. Above this bed is a zone of *Balanus*, while below the rock is merely painted over with nullipore.

On breaking into the smooth incrustation it is almost always found to consist, not of nullipore alone, as would be concluded from its external appearance, but largely also of the shells of one of the fixed Gastropods (*Vermetus*), the interstices between the coiled tubes alone being filled in by the Alga.

In the partial shelter of the bays the character of the incrustation changes, as well as diminishing in thickness. The complete series of changes is well illustrated in the vicinity of Port Sal Rei, Bonavista, as one passes from the complete shelter of Pequena Island to the exposed rocks of the N.W. corner of the island. At first nullipores are practically absent, but the shore is covered by flat round stones, each of which consists of a nucleus of volcanic rock, the diameter of which has been trebled by the addition of a mass of the *Vermetus* round its sides. Passing northwards, where the surf begins to take effect, nullipores appear in conjunction with the *Vermetus*, forming a more or less smooth incrustation four inches to a foot in thickness, while outside the Pequena Channel the foliaceous species of nullipore appear as at Bird Island and other exposed coasts, and the proportion of *Vermetus* has greatly decreased. The mode of growth of the *Vermetus* results in the enclosing of spaces between its own mass and the surface of the rock, which communicate with the outer water by numerous holes and crevices. As would be expected,

* Millipore is fairly common in many places in these islands, forming incrustations or sparsely-branched growths.

these spaces are the habitat of a rich fauna; they are often practically filled with Lamellibranchs and free-living Gastropoda, while Polychæta, Sipunculids, small Crustacea (especially Amphipoda), Nemertines, and even Centipedes can be washed out in great abundance. Boring Lamellibranchs (*Lithophagus* sp.?) are common, sometimes astonishingly so, but Polychæta and Sponges of this habit are far rarer than in the pure Alga or Coral of the shore-pools and bottom below tide-level. Further north still, where the surf breaks strongly, the surface of the incrustation becomes more or less bare of the mossy weeds and more or less foliaceous, and on breaking into its smooth portions the proportion of *Vermetus*-tubes is found to have greatly decreased. Further on are inaccessible rocks, covered with the light brown branched nullipore described above.

In some localities, *e. g.* the promontories just south of St. Vincent Harbour, an Eupsammid coral forms the lower part of the band of incrustation. This is always in a friable condition, and large pieces can be detached by the bare hand.

The incrustation is soft but tenacious, so that a crowbar must be driven in several times before a piece can be detached. Indeed, I found the best way of breaking it from the rocks to be by hammering in the blade of a spade. I saw no evidence of pieces being broken away by the waves, so that the causes of the limitation of these growths to masses rarely so much as one foot thick are not evident. Owing to the limitation of the zone to so narrow a band of these steep shores, continued growth would result in the formation of an unsupported shelf, which would at once be broken away by the sea. But I believe the action of boring-organisms to be more important. Physical conditions doubtless are the prime factors in determining the balance of life, and here they seem to have given the predominance to the agents of destruction, while the cold currents from the north account for the subordinate position of the Corals. A great amount of rock-formation is going on at depths of from 5 to 20 fathoms. Where-ever I have dredged in from 5 to 10 fathoms (St. Vincent, Porto Praya, and Bonavista, text-figs. 26, 25, and 24), nodules of nullipore *Lithothamnion* * are strewn abundantly over the bottom. From 10 to 20 fathoms two more delicate kinds occur, one being soft and foliaceous, the other consisting of thin and brittle branches. The fate of these I do not know, but of the nodules the great majority are rendered rotten by Sponges and boring Polychæta, finally breaking down to a grey mud. Among and below these Algæ there is a coarse sand formed almost entirely of a large foraminiferan. This covers practically the whole floor of St. Vincent Harbour between the 5 and 20 fathom lines, but finer sand and mud are plentiful in Porto Praya, and sand of volcanic origin in Bonavista. In St. Vincent the resulting mud from the destruction of the organic rocks appears to be carried to

* Herdman's 'Pearl-Fishing Report' contains an excellent illustration of these But in Ceylon the agents of destruction seem to be different.

deep water, but the coarser particles of nullipore and some coral, and the shells of the foraminiferan mentioned, form beach-sand and sandstone. Between low-tide level and 3 to 5 fathoms the sand is grey from admixture of black volcanic rock.

Text-fig. 25.

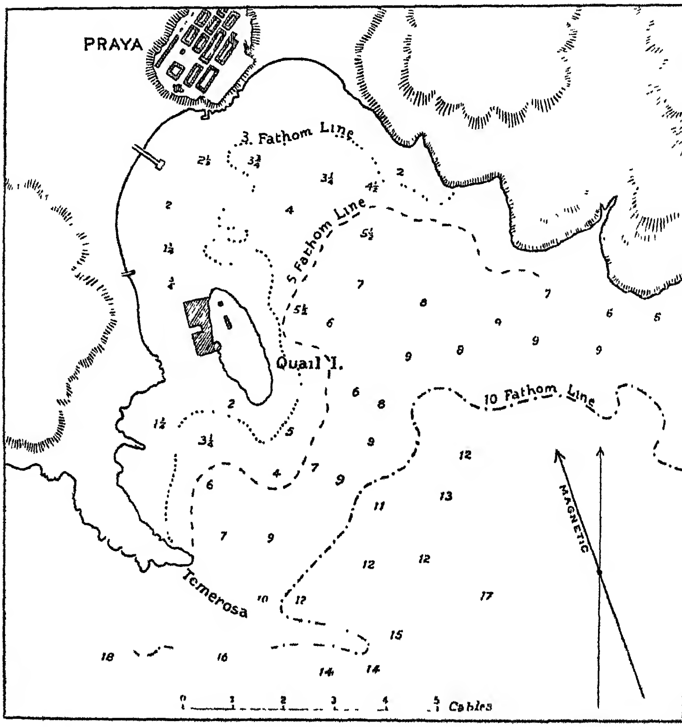


Chart of Porto Praya.

The following list of boring organisms is in the order of their importance in these islands:—

(1) *Sponges*, yellow or red, are abundant in every kind of calcareous matter excepting the masses of *Vermetus* in combination with nullipore, when the proportion of the latter is below about one half. Wherever pure nullipore is found, in tidal pools, surf-beaten rocks, or the sea-bottom, it is almost always riddled with sponge, or shows the effects of having been attacked in the past. Coral or nullipore colonies are rarely free, though the action of the sponge upon these seems to be slower. Certain species of shell are invariably attacked, *e. g.* those of the large species of *Strombus*, which is so abundant, are invariably riddled unless the mollusc is quite young. A large red Oyster is invariably attacked,

also during the life of the animal, but *Pecten* remains free. The upper coils of Gastropoda are generally bored, but a large white *Murex* escapes. The sponge seems to have a selective action in the case of living organisms—*e. g.*, a dead oyster-shell was dredged which had been riddled with sponge: on one side was growing nullipore and on the other a thick soft crust of Polyzoa, both of which were free.

The small irregular cavities enclosed by the growth of encrusting species of nullipore are a great aid to the spread of the sponge through the mass. The more solid Astræid Corals are far less rapidly attacked. Hemispherical lumps, apparently long dead, are frequently dredged, which are quite white and clean inside except for a tinge of red near the surface, or one or two layers of the same concentric with this. Some of these lumps have as nuclei a nullipore nodule, which is absolutely rotten.

(2) *Polychæta.*—*Lysidice*, *Nicidion*, two species of Sabellidæ, *Dodecaceria concharum* and *Eunice siciliensis* are ubiquitous in the same places and generally in company with the sponge. Of these the Eunicidæ are the most important, but the one large species, *E. siciliensis*, the great borer of the Indo-Pacific Corals, is rare. The Sabellidæ, which are not so conspicuous as borers in East Africa, here occupy an important place. *Dodecaceria*, the well-known shell-borer of European seas, here occupies a subordinate position. Wherever found it occurs in numbers together, but it does not occur with anything like the frequency of the Eunicidæ and Sabellidæ. A favourite habitat for this and other species is the base of coral-colonies. Splitting an encrusting Astræid from the lava rock usually lays bare a number of galleries and their occupants. The small Eunicidæ *Lysidice* and *Nicidion* are especially characteristic borers of the encrusting nullipore of exposed positions, the Sabellidæ of dredged *Lithothamnion* nodules, but either may occur in any position. Although in all cases sponge seems to be the first of the attacking host, yet in the case of the Astræid Corals, whose pores are too minute for the purpose, the rapid spread of the sponge is dependent on the presence of *unoccupied* worm-burrows, around which are seen extensions of the red tint from the surface, or other zones, into the white and as yet unattacked portions of the mass. The final state of a nullipore nodule is a grey mud enclosed in a thin shell of still growing Alga. The Sponge and boring Polychæta have now disappeared, the sole inhabitant being a large but remarkably fragile Capitellid worm.

(3) The Lamellibranch *Lithophagus* is abundant in Corals; nullipores are nearly always infested and very often are quite full of it. This species is notable as being the only borer to attack the Serpulid and nullipore compound when the proportion of the latter is low.

Lithophagus lines its burrows with a hard enamel-like secretion which is not attacked by sponge until after the death of the mollusc.

(4) *Sipunculoidea*: *Aspidosiphon* is common in both nullipore and Coral.

(5) *Echinoderms.*—Boring Echinids (*Echinometra subangularis*) occur all round the coasts in enormous numbers, in shallow pools of the shore-platform; the holes are generally drilled as near together as is possible. Just below the steep incrustation-belt they occur again in the same profusion, but in the belt itself are much rarer, except where it is horizontal. It is very remarkable that this form produces equally conspicuous effects upon rock of all degrees of hardness, whether nullipore, coral, sandstone, or the very hard black basaltic rock.

But the total result of their destructive action is small, *e. g.* on sandstone of the St. Vincent reef amounting to the deepening of shallow pools by three or four inches. Indeed in many cases the Echinid merely takes advantage of the peculiar "potholed" forms the calcareous rocks assume under the influence of the sea and does no drilling at all. In any case as soon as shelter is obtained drilling-operations cease, and naturally sheltered crevices show feeble, merely adaptive traces of this action. On exposed surfaces as soon as the recess is made deep enough for shelter the action ceases, though several generations of Echini occupy the same place, as is shown by the fact that the size of the hole has often no relation to that of its occupant, full-grown Echini frequently occupying extremely shallow depressions and in other cases a young specimen, an inch or so across, being in possession of a full-sized hole, 3 inches in diameter and depth.

But on growing Coral the action is more important. Whenever a colony comes to overhang a burrow it is eaten away and this portion killed, as though semicircular canals had been gouged out in a line with the edge of the burrow beneath. In this way pools which would be full of coral possess but stunted remnants, and the extent of coral-growth on these coasts is very greatly reduced.

It should be noted that these are not the only borers the instincts of which may be satisfied by an accidental crevice. I have found even so highly specialised a borer as the Polychæte *Eunice siciliensis* inhabiting natural crevices in the nullipore and Serpulid combination.

5. The St. Vincent Fringing-Reef.

Although true "coral-reefs" are absent from these seas, a remarkable simulacrum of a nullipore fringing-reef exists immediately to the south of the town of St. Vincent. The Admiralty chart gives a much larger structure than that at present in existence. In fact, there have been two distinct though perfectly similar reefs, the northern and broader having been now completely removed to make room for the piers &c. of the Coaling Companies. The two reefs were separated by lava rock at the base of a volcanic hill, 100 feet high, on the shore, the importance of which will appear later.

The surface of the reef is at a level of from one to two feet above that of lowest tides, on the whole flat, with shallow pools,

but in one part a larger channel exists on its land side. In this a constant current is produced by the flowing away of the spray thrown over the reef-edge to the northerly opening of the channel. Obviously this current is the means by which the channel was produced. Landwards is a sand-beach, and in places a small amount of very soft beach-sandstone, at a level of about three feet vertically above the reef-flat.

Text-fig. 26.

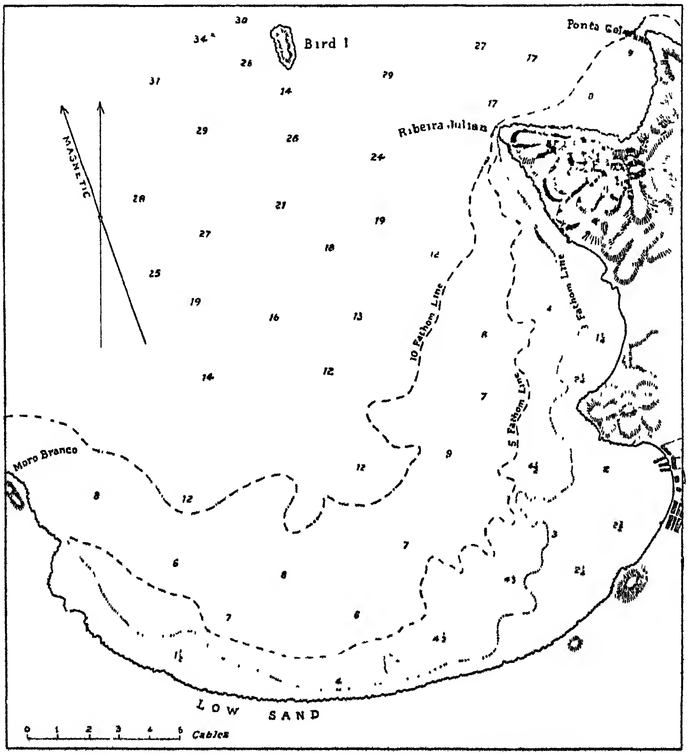


Chart of Porto Grande.

The edge is irregular, consisting of a line of rock-masses of nearly equal height, *i. e.* a few inches higher than the general level, and usually perfectly continuous with the reef-flat, and its surface is completely covered with nullipore giving a characteristic irregularity. There is a precipitous drop into one or two fathoms of water, beyond which is a slope of sand and stones. In short, all appearances are those of a growing nullipore-reef with beach-sandstone towards its landward side, but examination shows that sandstone extends to the seaward edge, being merely plastered

over with the usual incrustation above described. Of the seaward projecting masses the raised part is in some cases entirely composed of organic matter, of others the corresponding rock is sandstone thinly coated with nullipore.

It is here that the mode of growth of the *Vermetus* is best seen. Under the influence of the sea calcareous rocks usually become hollowed into a series of concavities separated by sharp ridges and pinnacles. On the seaward side of this reef these ridges are occupied by *Vermetus*-tubes alone. The coils of shell grow out horizontally from the top of the ridge, on either side, forming broad cake-like masses which cover over the depressions between the adjacent ridges as though one had laid a flat stone across. In the same way, but on a smaller scale, are doubtless formed those cavities in the incrustations of the lava rocks which are the habitat of an important constituent of the fauna.

As one passes to the actual edge of the reef these colonies of *Vermetus* become combined with nullipore, the proportion of which rises until at the extreme edge the compound rock is half or more than half nullipore.

Rock-boring organisms are here *comparatively* rare, and Sponges and Polychæta of this habit are entirely absent! The other borers are common enough, but the *Vermetus*-tubes are apparently too hard and the intervening layers of nullipore too narrow for these.

The rock beneath is a sandstone of very variable fineness and hardness, usually harder at its seaward edge, and softest at the top of the beach—when it occurs there. It is distinctly stratified, the strata being nearly horizontal or with a slight but distinct dip landwards. The surface is cut into hollows and sharp ridges in the way characteristic of "Coral-rag." In composition the rock is practically completely calcareous, consisting of an agglutination of foraminifera (the large species mentioned as forming the coarse sand of the bay) and more or less finely broken shells. It is noteworthy that the sand of the beach consists of exactly the same materials and in both is found a small quantity of dark grey sand of volcanic origin. Rolled black pebbles are included, and sometimes the rock is almost a conglomerate of such, and shells, apparently those of the present day, are frequently met with. This rock is bored by the Lamellibranch *Lithophagus* and the Echinid *Echinometra subangularis*, but not by Sponge or Polychæta, &c.

The formation of this rock has taken place in the same way as the sandstone-reefs off the river-mouths of Brazil. There are no rivers in St. Vincent (where the rainfall of the past three years has amounted to just three inches), but these reefs are situated at the mouths of two flat valleys which slope gently up to the mountains of the centre of the island, and are separated by the hill on the shore referred to above. Water continually percolates down their beds, and even flows over their surfaces after very heavy rain. This water takes up lime in solution from the

shallow beds of limestone which clothe the lower slopes of the sides of these two valleys, and this is deposited as the cement of the sandstone when the fresh water mixes with the salt.

But for the interference of tides and waves the level of this rock-bed would be that of the valley, *i. e.* the top of the sand-beach, where indeed a very soft rock does occur. But the sea has cut down this mass to the level determined by the height of the tides &c. in the usual way. As in the case of the reefs of Zanzibar, we are here shown how purely physical causes, aided by protective organic growths, can produce reefs closely resembling those the mass of which is due to growth of organisms *in situ*, which leads to the conclusion that the forms characteristic of true coral-reefs are very largely due to the physical action of the sea as well as to the laws of growth of the organisms themselves.

That the formation of this sandstone-rock is still proceeding seems most probable, and it would be interesting to know definitely the conditions of the landward side of the strata underneath the alluvium of the valley. The solvent and eroding actions of the sea are very nearly balanced by the growth of calcareous organisms, but the presence of outlying rocks and submerged masses indicate that the sea is slowly encroaching. It is probable that cementing of fresh material is being carried out on the landward side of the strata at the point where fresh and salt water meet—a point which is moved backwards just as fast as the sea encroaches.

It is to be noted that the occurrence of beach-sandstone is not confined to valley-mouths. Smaller deposits occur elsewhere, and a sample I collected at the north point of St. Antonio has the appearance on the surface and the extreme hardness characteristic of the East-African "Coral-rag."

6. Summary and Conclusions.

1. *Faunistic.*—Although the Indo-Pacific Oceans are one faunistic area, there is no fauna common to the tropical seas of the world, so far as the evidence of the Cape Verde Islands goes, though *certain species* are common to the Tropics of both Atlantic and Indian Oceans. If the Tropical Atlantic is a distinct area characterised by a special fauna, its northern limit is carried far to the south by cold currents (and probably northwards in the south), as in spite of the position of these Islands, between 17° and 15° N.*, their fauna has a considerable constituent derived from the subtropical zone. But it may later appear that this portion of the fauna is unduly conspicuous through its species being already well-known, while the constituent derived from the Tropical Region, if any, will not be known until the systematic examination of the collections is completed.

The scanty representation of some groups (*e. g.* Corals and

* Compare the fauna of Suez Bay, which is tropical, though situated in latitude 30° N.

Alcyonaria) and practical absence of certain families of others (*e. g.* Chromodoridæ and Pseudoceridæ, of Nudibranch Mollusca and Planarian worms respectively) may be features indicative of a subtropical fauna, or indications of the existence of a different balance of life obtaining in the two Oceans.

2. *The Formation of Organic Rocks.*

(*a*) Between tide-marks by two kinds of Nullipore and *Vermetus*-tubes, principally by the encrusting nullipore and the tubes in combination. An enormous quantity of these calcareous growths is present on these coasts, though only as an incrustation a few inches thick. The absence of reefs may be due to the small vertical range of these growths on a remarkably steep coast, but especially to the extraordinary abundance of boring Sponges, Polychæta, and Mollusca, which more or less infest almost every fragment.

(*b*) Below tide-marks, 5-10 fathoms, by the growth of nodules of *Lithothamnion* and great quantities of a foraminiferan. The former is usually reduced to fine grey mud by boring organisms. In 10-20 fathoms, by two more delicate species of red Alga and by the above-mentioned foraminiferan.

3. *Beach-Sandstone* is formed by the deposition of calcareous cement from fresh water on meeting the salt. The action of the sea upon this rock has in one case produced a remarkable simulacrum of a growing fringing-reef, which, however, is not being extended by the growth of organisms upon its margin, but slowly eroded by the sea. The total extent of this formation is insignificant in proportion to the organic incrustations above.

March 21, 1905.

G. A. Boulenger, Esq., F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions that had been made to the Society's Menagerie in February 1905:—

The registered additions to the Society's Menagerie during the month of February were 103 in number. Of these 26 were acquired by presentation, 16 by purchase, 39 were received on deposit, 21 by exchange, and 1 was born in the Gardens. The total number of departures during the same period, by death and removals, was 94.

Amongst the additions special attention may be directed to:—

1. A female Kiang (*Equus hemionus kiang*) from Eastern Tibet, deposited by H.M. The King on Feb. 23rd.

2. A male Lynx (*Felis lynx*) from the Caucasus, received in exchange on Feb. 24th.

3. A male Leopard of the Persian race (*Felis pardus tulliana*), received in exchange on Feb. 24th.

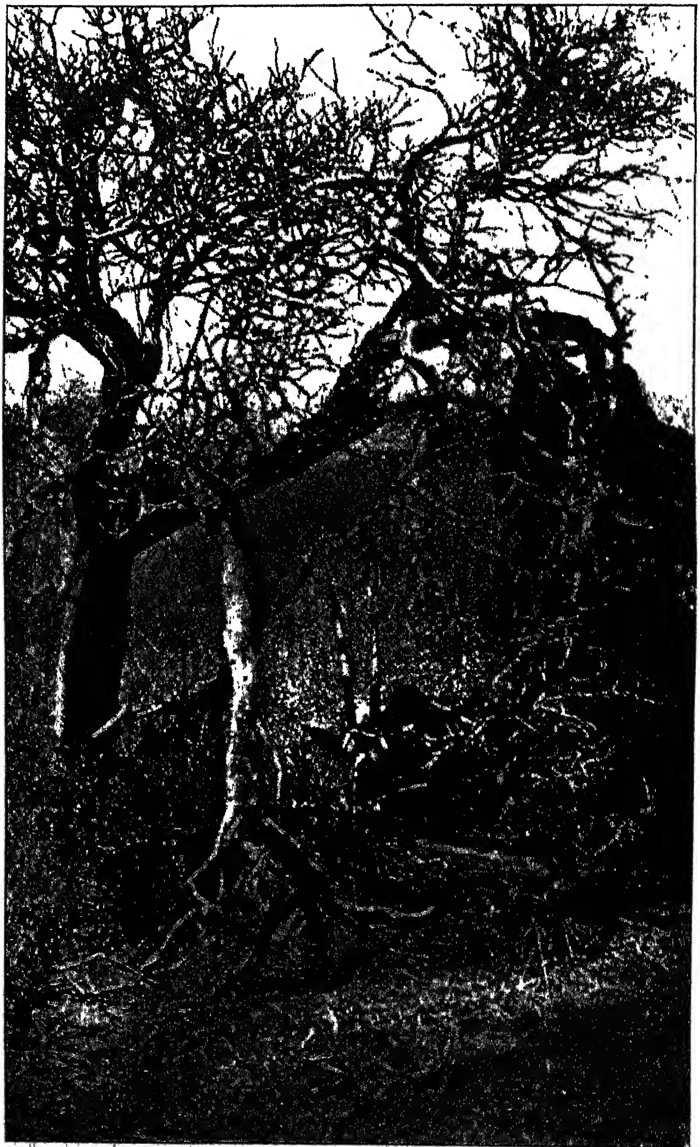
4. A semi-albino variety of the Common Fox (*Canis vulpes*) from Essex, deposited on Feb. 7th.

The Secretary read an extract from a letter that had been written to him by Mrs. S. L. Hinde, who had kept a number of animals in captivity at her husband's station in the Kenya district, British East Africa. He remarked that much had been recorded as to the urgent desire for salt shown by herbivorous animals, but that he was unaware of any observations as to the gratification of the instinct in a manner so unusual as that observed by Mrs. Hinde, who was a competent and trustworthy observer. The following is the extract in question:—

"You asked me to tell you in detail how my Antelope became a murderer. He was a Duiker (*Cephalophus*), and became a member of my Zoo when a few days old. He was suckled by a goat, and was one of the few antelopes I have succeeded in rearing; he was never ill, and always seemed in excellent condition. My Zoo was a fairly large space, surrounded with wire-netting, and contained the Duiker, a Dik-dik, a large family of Dassies (which bred in captivity), and various species of Francolins, Guinea-fowls, and Pigeons. They lived happily together and never seemed to fight, but not unfrequently I found one of the birds literally beheaded. I thought that the Dassies were the culprits, as they used to chase the green pigeons to eat their fruit, so much so that ultimately these pigeons became grain-feeders, doing well on the changed diet. One day, however, when a new partridge, just captured and weak from flight, had been put in the enclosure, I saw the Duiker go up to it, put one hoof on its back, and bite its head off. He was evidently the murderer, but simply because he needed salt. How he knew he could get it from blood is unexplained, but he evidently did. From that time quantities of rock-salt were kept in the enclosure, and there were no more beheaded birds."

Mr. Frederick Gillett, F.Z.S., exhibited a photograph of a wounded Oryx (*Oryx beisa*) hiding under a mimosa-bush (text-fig. 27, p. 188), showing, what might be taken as an example of protective coloration. He, however, expressed the opinion that protective colouring only really took place in insects, birds, and small animals the enemies of which were birds, and that the larger animals which were preyed on by the cat and dog tribes, who hunted by scent, did not require protective coloration. He put down the difficulty of seeing large animals in their native haunts to the fact of their being able to remain absolutely still for long periods, holding the view that any animal in any ordinary surroundings would become practically invisible by remaining motionless.

Text-fig. 27.



Wounded Oryx hiding in bushes.

Mr. C. Tate Regan, B.A., F.Z.S., exhibited an interesting series of pencil-sketches of Fishes of the Rio Negro and its tributaries, made by Dr. A. R. Wallace about fifty years ago. Most unfortunately the magnificent collection of Fishes which they represented, containing examples of about 200 species, was lost on the voyage home. Dr. Wallace had presented the drawings, accompanied by notes on the dentition, the number of fin-rays, and the coloration, to the British Museum, and Mr. Regan had been engaged in their determination. A complete list of those which he had been able to identify follows, but in the case of the others, a large proportion of which probably represented species as yet undescribed, it had seemed best not to reproduce the drawings nor to publish notes on them, but they served to illustrate the incompleteness of our knowledge of the fishes of the Amazon and its tributaries. For example, the Cichlid genus *Crenicichla*, a revision of which was read before a recent meeting of this Society, was represented by 10 species. Of these only 5 had been determined, including *C. lenticulata* Heck., unrepresented in the British Museum Collection, and one described from the Essequibo under the name of *C. wallacii* *. The other 5 had very distinctive characters, and certainly did not belong to any of the species recognised in Mr. Regan's revision. It was rather curious that Dr. Wallace should have collected so few Loricariidæ. The remarkable habits of the little Silurid *Vandellia cirrhosa* had been the subject of a communication made to this Society by Mr. Boulenger (Proc. Zool. Soc. 1897, p. 901), and it was interesting to read Dr. Wallace's notes on this subject †:—"The stomach is generally more or less filled with blood as it [the fish] attaches itself to other fish and aquatic animals and sucks them. This minute fish enters the urinary passage of men and women, wounds and extracts blood within, and all efforts to extract it are usually unavailing. Effusion of blood, inflammation, and death have in several instances occurred."

The Fishes identified were:—

Torpedinidæ:—*Tæniura motoro* Müll. & Henle.

Osteoglossidæ:—*Osteoglossum bicirrhosum* Vandelli.

Symbranchidæ:—*Symbranchus marmoratus* Bl.

Scombresocidæ:—*Belone tæniata* Günth.

Characinidæ:—*Macrodon trahira* Spix; *Erythrinus unitæniatus* Spix, *E. salmoneus* Gronov., *E. longipinnis* Günth.; *Pyrrhulina filamentosa* Cuv. & Val.; *Curimatus schomburgkii* Günth., *C. spilurus* Günth., *C. alburnus* Müll. & Trosch., *C. elongatus* Spix; *Prochilodus insignis* Schomb.; *Hemiodus immaculatus* Kner, *H. unimaculatus* Müll. & Trosch.; *Anostomus tæniatus* Kner, *A. gracilis* Kner; *Leporinus fasciatus* Bl., *L. affinis* Günth., *L. nigrotæniatus* Schomb., *L. striatus* Kner, *L. frederici* Bl., *L. leschenaultii* Cuv. & Val., *L. nattereri* Steind., *L. margaritaceus* Günth.;

* Regan, *supra*, p. 163, pl. xiv. fig. 2.

† See also note in Arch. de Parasitol. vii. 1903, p. 168 (1904).

Agoniates halecinus Müll. & Trosch.; *Cynodon pectoralis* Günth., *C. scombroides* Cuv.; *Xiphostoma ocellatum* Schomb., *X. lateristriga* Bouleng.; *Xiphorhamphus ferox* Günth., *X. falcirostris* Cuv.; *Tetragonopterus bartletti* Günth., *T. oligolepis* Günth., *T. wappi* Cuv. & Val., *T. caudomaculatus* Günth., *T. grandisquamis* Müll. & Trosch., *T. chrysargyreus* Günth., *T. abramis* Jenyns, *T. chalceus* Agass.; *Brycon pesu* Müll. & Trosch., *B. schomburgkii* Müll. & Trosch.; *Chalceus macrolepidotus* Cuv.; *Megalobrycon cephalus* Günth.; *Crenuchus spilurus* Günth.; *Serrasalmo denticulatus* Müll. & Trosch., *S. scapularis* Günth., *S. gymnogenys* Günth., *S. humeralis* Cuv. & Val.; *Myletes schomburgkii* Müll. & Trosch., *M. ellipticus* Günth., *M. setiger* Müll. & Trosch., *M. duriventris* Cuv., *M. rhomboidalis* Günth., *M. rubripinnis* Müll. & Trosch., *M. asterias* Müll. & Trosch., *M. hypsauchen* Müll. & Trosch.; *Anacyrtus gibbosus* L.

Gymnotidæ:—*Sternopygus carapus* L.; *Carapus fasciatus* Pall.; *Gymnotus electricus* L.; *Sternarchus nattereri* Steind.

Siluridæ:—*Vandellia cirrhosa* Cuv. & Val.; *Callichthys longifilis* Cuv. & Val., *C. asper* Quoy & Gaim.; *Cetopsis cæcutiens* Licht.; *Asterophysus batrachus* Kner; *Oxydoras stenopeltis* Kner, *O. lipophthalmus* Kner, *O. carinatus* Cuv. & Val.; *Doras cataphractus* L., *D. heckelii* Kner; *Ageniosus militaris* Bl.; *Centromochlus heckelii* Filippi; *Platystoma planiceps* Agass., *P. tigrinum* Cuv. & Val.; *Callophysus lateralis* Gill; *Platynematichthys punctulatus* Kner; *Pirinampus typus* Agass.; *Pimelodus holomelas* Günth., *P. muelleri* Günth., *P. maculatus* Lacep., *P. ornatus* Kner, *P. eques* Müll. & Trosch., *P. cristatus* Müll. & Trosch., *P. sebæ* Cuv. & Val., *P. raninus* Cuv. & Val.; *Phractocephalus hemiliopterus* Bl. Schn.; *Piratinga goliath* Kner.

Loricariidæ:—*Loricaria carinata* Casteln., *L. maculata* Bl.; *Plecostomus guacari* Lacep., *Ancistrus gibbiceps* Kner, *A. brachyurus* Kner, *A. pictus* Casteln.

Sciænidæ:—*Sciæna amazonica* Casteln.

Cichlidæ:—*Cichla ocellaris* Bl. Schn., *C. temensis* Humb.; *Geophagus jurupari* Heck., *G. dæmon* Heck., *G. cupido* Heck., *G. surinamensis* Bl.; *Acaropsis nassa* Heck.; *Acara vittata* Heck., *A. tetramerus* Heck.; *Crenicichla johanna* Heck., *C. lugubris* Heck., *C. lenticulata* Heck., *C. saxatilis* L., *C. wallacii* Regan; *Cichlosoma coryphænoides* Heck., *C. severum* Heck., *C. festivum* Heck.; *Pterophyllum scalare* Cuv. & Val.

Mr. Macleod Yearsley, F.Z.S., exhibited an X-ray photograph of a living Ring-Snake (*Tropidonotus natrix*), taken by Dr. F. H. Low a short time after it had swallowed a couple of frogs. The skeleton of the snake was shown very clearly, and the bones of its prey could be very easily made out within its body.

Mr. R. E. Holding exhibited and made remarks upon three skulls of the Fallow Deer (*Dama vulgaris*), showing arrest of,

or abortive nodular growths in, the antlers, due to complete, or incomplete, castration; also two Red Deer skulls (*Cervus elaphus*), showing congenital absence, or modification in the growth, of the antlers.

The following papers were read:—

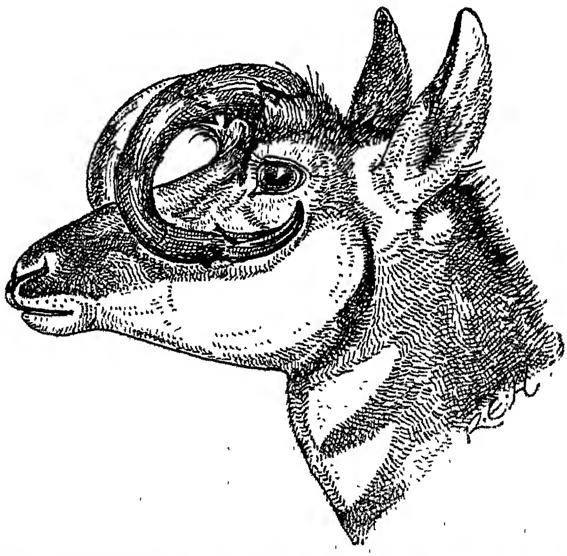
1. The Effects of Castration on the Horns of a Prongbuck (*Antilocapra americana*). By R. I. Pocock, F.L.S., F.Z.S., Superintendent of the Gardens.

[Received February 21, 1905.]

(Text-figures 28 & 29.)

The Zoological Gardens recently received on deposit an adult male Prongbuck remarkable for the abnormal development of the horns, which, instead of rising vertically from the forehead, curve from the root boldly forwards, then downwards, then backwards, like a pair of teapot-handles, each ending in a slightly incurved point close beneath the eye (text-fig. 28). There also appears at first sight to be no trace of the anterior tine or prong characteristic of the normal horn.

Text-fig. 28.



Lateral view of head of a castrated Prongbuck, showing the abnormal growth and shape of the horns.

A writer in the 'Field,' on February 4th, commenting on the

animal, remarked that it "evidently bent its horns when young, probably in a fence." This explanation, however, even if no other were forthcoming, would not, in my opinion, account for all the peculiarities of the case. For, apart from the more deep-seated modifications enumerated below, the horns differ in three particulars from those of a typical Prongbuck—namely, in direction, in the practical suppression of the anterior tine, and in shape, being subcylindrical and lacking the lateral compression and basal antero-posterior width observable in the normal horn. An injury of the nature suggested might perhaps produce permanent malformation; but it seems hardly likely that with subsequent growth the malformation would follow the same line of development in the two horns, and result in identity in length and similarity in shape and symmetry.

After the appearance of the notice in the 'Field,' Mr. Thomson, the Assistant Superintendent of the Gardens, discovered that the Prongbuck had been castrated. Castration usually has a marked effect upon secondary sexual characters; and since the discrepancy in size between the horns of the bucks and does of *Antilocapra* justifies the inclusion of these structures in that category of organs, one would expect abnormality in the growth of the horns to be caused by the operation in question.

I am not aware that any observations on the effects of castration on the Prongbuck have yet been published. In the case, however, of Fallow Deer, its results have been recorded in a few cases by Dr. G. H. Fowler (P. Z. S. 1894, pp. 485–494), who summarises his results, based upon the evidence of undisputed data, under five headings, as follows:—(1) Complete castration at birth may result in the formation of simple dags. (2) Castration late in life may produce great asymmetry in the antlers. (3) Antlers of castrated deer can be shed; if castrated after the horns for the year are burnished [*i. e.* have lost the velvet], the animal may shed them prematurely; antlers put up after castration may be retained for at least two years. (4) Partial castration soon after birth may result in a comparatively feeble but normal development of the antlers. (5) Castration on one side may result in the nearly normal development of one antler, and in abnormality and reduction of the other*.

Although the shedding of the antlers in Deer is a phenomenon only analogous to that which takes place in the Prongbuck, and although the horns of the Prongbuck, inasmuch as they are sometimes, at all events, present in the female, have not quite so strong a claim to be regarded purely as secondary sexual organs as those of the Fallow Deer, where they are confined to the male, we should nevertheless look for somewhat similar variations to be caused by castration in the two animals. And assuming the

* A valuable summary of this question may be found in Mr. J. T. Cunningham's book on 'Sexual Dimorphism in the Animal Kingdom' (1900). I learn from Mr. F. C. Selous that castration does not appreciably affect the horns of the Eland. In that Antelope horns occur in both sexes.

variations described below to be due to castration, it is evident that the operation has affected the horns in a very remarkable manner.

Description of the Horns.

Instead of rising from the forehead as upright, laterally-compressed, bony prominences, the horn-cores bend obliquely forwards in a vertical plane, their axes inclining to the plane of the forehead at an angle of about 45°. They are only about 2 inches long.

The horn-sheaths cover the core to the root, becoming gradually softer proximally, and passing into the hairy integument of the head. They project nearly horizontally forwards in the direction of the nose for a distance of about $3\frac{1}{2}$ inches, then curve downwards for about $2\frac{1}{2}$ inches, and then backwards towards the eye for about $3\frac{1}{2}$ inches, the terminal inch curving lightly inwards and downwards to a point close to the eye. Their total length along the outer or convex curve is thus about $9\frac{1}{2}$ inches. They also present a spiral twist forming about one-fourth of a complete turn. This is attested by the fact that an interfibrous groove starting in the middle line of what is morphologically the posterior surface of the base, but which by the change in the direction of growth has become secondarily the upper or dorsal surface of the horn, gradually passes on to its inner surface to terminate on the concave side of the apically curved portion, this concave area being also, morphologically, although it faces the middle line, part of the posterior surface of the horn, as is abundantly proved by the recurvature of the apex of the normally formed horn. The same extent of torsion is further shown by the lateral compression of the base of the horn being replaced by dorso-ventral compression towards the apex, the normal horn being laterally compressed throughout. Briefly stated, the result of the twist is to make the distal half of the posterior surface of the horn face the middle line of the body.

Although the horn-sheaths have been described above as if each corresponded to a single fully-formed horn-sheath of an adult Prongbuck, closer examination shows that they are in reality composite—that is to say, they consist of a series of horn-sheaths partially severed from each other. The exact number of sheaths involved in the formation of the whole is not easy to determine. There appear, however, to be six. In the right sheath, the outer or convex side shows a continuous and unbroken surface except at two points, the proximal break occurring at about $\frac{3}{4}$ of an inch from the base, and the distal a little more than $2\frac{1}{4}$ inches from the apex; there is, however, a partial break $1\frac{1}{2}$ inches behind the distal break. These three breaks are continued round the horn on to its convex side, and very evidently represent the proximal ends, formerly extending to the root of the horn-core, of three separate sheaths. Moreover, on the concave side there are two additional breaks in the continuity of the tissue which extend only half round the sheath, one situated at about $1\frac{1}{4}$ inches

from the antepenultimate break, the other about 1 inch behind the latter and $1\frac{1}{4}$ inches in front of the proximal break. These breaks divide the sheath superficially into six pieces—a proximal, a distal, and four intermediates, which for convenience of reference may be numbered, from apex to base, 1, 2, 3, 4, 5, 6.

No. 6, measuring about 1 inch in length, presents near the middle of its anterior (inferior) surface a very distinct blunt tubercle, representing, I believe, the prong of the normal horn. A similar but smaller boss is also present on its posterior (superior) side, and corresponds in all probability to the posterior angular prominence visible in the proximal half of the normal horn.

No. 5, measuring $1\frac{1}{8}$ inches, also exhibits on its anterior (inferior) surface, close to the base of no. 4, a small tubercle representing the prong; but there is no sign of any prominence on its opposite side.

No. 4, measuring 1 inch, has no tubercles.

No. 3 measures $1\frac{1}{4}$ inches, and shows a very slight eminence near its distal extremity.

No. 2, also measuring $1\frac{1}{4}$ inches, has no trace of the prong.

No. 1, measuring $2\frac{3}{8}$ inches, tapers to a point and forms a semicrescentic curve. There is no trace of a prong.

The measurements above given represent the lengths of the portions of the individual horn-sheaths left uncovered by the previously formed sheath, with the exception only of the 1st or distal sheath, the first formed of the series. This sufficiently explains the greater apparent length of the latter.

In longitudinal section, the true length of the separate sheaths is more clearly shown. The composite sheath may thus be seen to consist (1) of a solid horny central core extending from its tip to the apex of the cavity of the proximal piece, which fitted over the bony process of the skull, and serving to bind together the separate sheaths; and (2) of a cortical layer which is traversed by a large number of clefts running longitudinally and obliquely backwards and slightly outwards from the central core towards the periphery of the cortical layer. Of these clefts five only reach the surface, and, being larger than the rest, divide the sheath into the six component parts described above. The appearance of the whole series of clefts, however, forcibly suggests a corresponding number of attempts to get rid of the sheaths at different periods.

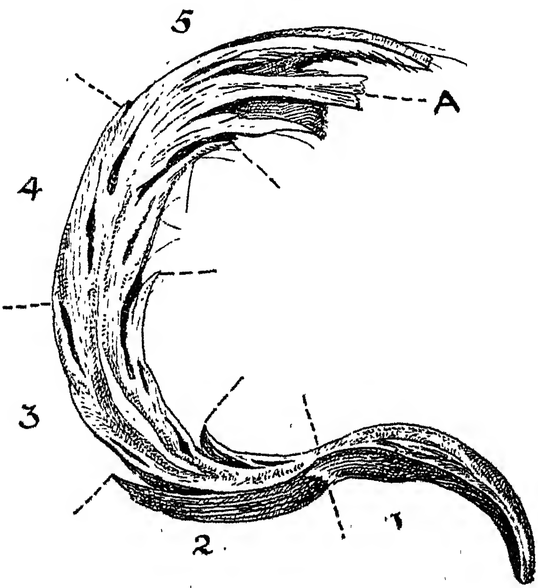
As already explained, a complete interruption of the continuity of the cortical tissue extending all round the sheath occurs only in two places, and admits of a certain freedom of movement between the adjacent portions of the composite sheath. The cleft defining the distal sheath extends so deeply as almost to sever this sheath from the apex of the antecedent or 2nd sheath, the portion of the central core that binds the two together being only about 2 mm. in thickness. Hence the distal sheath is freely movable. On the other hand, the central core that binds the proximal sheath (no. 6) to the previously formed portions of the

sheath is about $\frac{1}{4}$ of an inch thick, and allows of but little movement between the two. The remaining portions of the composite sheath are immovably welded together both by the solidity and thickness of the central core and by the unbroken continuity of the cortical tissues on the convex side of the horn-sheath.

The approximate length in inches of the sheaths (excluding the distal) is as follows:—No. 6, $2\frac{1}{2}$; nos. 5, 4, and 3, $2\frac{1}{4}$; no. 2, $2\frac{1}{8}$. In the proximal sheath the length of the hollow that fits over the bony core is $1\frac{1}{2}$; in the distal sheath it is $1\frac{1}{8}$ inches.

The horn that has just been described was not, I believe, shed in the ordinary way. It was picked up in the paddock adjoining that in which the Prongbuck was kept. The paddocks are separated by iron bars, and it seems probable that the horn, becoming entangled, was wrenched off by the animal in its efforts to get free. This is an explanation of its being on the wrong side of the fence, and also of the fact that the horn-core was naked and bleeding. In the case of normally-shed horn-sheaths, the core is covered with the new sheath before the old one comes away.

Text-fig. 29.



Section of the left compound horn-sheath of a castrated Prongbuck, slightly diagrammatic, showing the five component sheaths (1–5) and the extremity of the central strand (A) by which the fifth sheath (5) was fixed to the tip of the sheath left covering the horn-core.

The left horn-sheath (text-fig. 29) resembles the right in essential features. It appears, however, to consist of five, instead of six,

sheaths united by a solid central core. The proximal, or fifth, is separated from the fourth by a deep cleft extending more than half way round the sheath. It measures $1\frac{1}{2}$ inches, and presents on its concave (morphologically anterior) side a small but distinct and sharp tubercle representing the prong. The fourth, measuring $1\frac{1}{4}$ inches, is itself subdivided into two by a deep cleft, suggesting that it may represent two short, partially-separated sheaths. The third, which is marked off externally from the fourth by a deep but narrow cleft, measures $1\frac{1}{4}$ inches. Neither the fourth nor the third shows a trace of the prong. The second, measuring $1\frac{1}{8}$ inches, has, however, a very pronounced tubercle; it is separated from the third by a deep cleft completely encircling the sheath. A similar complete cleft also marks the divisional line between the second and first, which is curved as in the right horn-sheath and measures about 2 inches.

In longitudinal section this sheath is also like that of the right side. The individual components are firmly welded together by the solid central core, and the cortical layer is subdivided by oblique clefts, some of which fall short of the periphery of the sheath and are visible only in section, while others are carried through to the surface and mark the spaces between the sheaths. The lengths of the latter from base to apex, as shown in section, are as follows:—Nos. 5–2 about $2\frac{1}{2}$ inches, no. 1 about $2\frac{1}{8}$ inches.

The left horn I removed from the animal's head myself. It was loose, and the fibres at its base were easily ruptured by rotation. The sheath came partially away from the horn-core, leaving it covered with a horny cap, the last-formed sheath. This cap, however, was firmly united apically to the angle of the socket of the antecedent sheath by a solid horny strand continuous with the central core traversing the length of the composite horn-sheath and binding its constituents together. This strand (text-fig. 29, A) had to be severed with a knife before the sheath could be removed. The presence of this horny cap upon the left horn-core and the naked and bleeding condition of the right one sufficiently explain the presence of six horn-sheaths in the right and five in the left detached composite sheath.

The effects of castration on the horns of the Prongbuck may thus be summarised as follows:—

1. *Modification of the Horn-cores.*—These are shortened and bent obliquely forwards and outwards at the apex, causing the sheath to project in the direction of the nose.

2. *Modifications of the Horn-sheath*:—

   a. Shedding of the sheath does not take place.

   b. The first-formed sheath is normal in shape, and at the time for shedding breaks away from the second except at the point where the apex of the latter joins the angle of the cup of the former. A similar partial severance separates the succeeding sheaths from each other.

c. The result of this incomplete separation of the sheaths is the formation of a composite sheath which would presumably go on increasing in length so long as new sheaths were formed from the horn-core.

d. With the exception of the first, each newly-formed sheath is like its predecessor in shape and length, and differs from the fully and normally formed sheath of an adult animal in being subconical, with the point straight, and the prong either unrepresented or represented by a small wart-like tubercle.

e. The composite sheath at first grows forwards, then downwards, then backwards, and is affected by a slight spiral twist, causing the posterior surface of its distal extremity to face the middle line.

2. Notes on the Mammals and Birds of Liberia. By Sir Harry H. Johnston, G.C.M.G., K.C.B., F.Z.S.

[Received March 21, 1905.]

Liberia, as seen on the map, is little more than the southernmost prolongation of the region which might be styled Northern Guinea. The southernmost point of Liberia, at the mouth of the Cavally River, is the most southerly extension of the true West Coast of Africa. At this point the West Coast reaches to within little more than 4 degrees of the Equator. Although this country is not marked off clearly by any natural features either from Sierra Leone on the one hand or the Ivory Coast on the other, it possesses a certain distinctness and a slight degree of peculiarity as regards its flora and fauna. The botanical collections that have been made by those who have been working with me recently in Liberia have brought to light several genera and a large number of new species of plants which appear to be restricted in their distribution more or less to the political limits of this Negro republic. I do not think that quite the same degree of peculiarity can be ascribed to the fauna even amongst vertebrates, which offer the greatest amount of specialisation or exclusive distribution. As regards mammals and birds, Liberia is to a great extent a meeting-place for the forms of Northern Guinea (Sierra Leone to the Gambia) and those of the Gold Coast, the Niger Delta, and the Cameroons. Some types find Liberia their northernmost or westernmost limit of range from the Congo Basin, the Victoria Nyanza, and the Bahr-el-Ghazal. Of such may be noted, besides various birds, the Bongo Antelope, which is found abundantly in Liberia, but which does not, I believe, extend its range much to the west of that country. Also the Red Congo Buffalo. I fancy I am correct in saying that this type, the horns of which I have seen in the interior of Liberia, does not differ from the Red Buffalo of the Congo, but that it scarcely

extends westwards into Sierra Leone, where the Senegalese type of buffalo is met with. This last may be distinguished from the Congo Buffalo by its slightly longer horns with less expanded bases, and by the tendency to black in the colour of the hair*. Liberia is also, I believe, the westernmost range of the Diana Monkey.

This country is chiefly remarkable, as regards the possession of peculiar species of mammals, for the Liberian Hippopotamus, the Zebra Antelope (*Cephalophus doriæ*), Jentink's Duiker, and Büttikofer's Monkey. It is not to be supposed that these creatures carefully discriminate between the political boundaries of Sierra Leone, Liberia, and the Ivory Coast; and in all probability as a zoological district one may have to include within the limits of Liberia a portion of the eastern part of Sierra Leone and of the western part of the Ivory Coast, where the dense Liberian forests extend across the political frontiers. But, so far as present research goes, the creatures above named appear to be restricted in their distribution to the Liberian area. I do not think any trace of the Liberian Hippopotamus has been found in any other part of Africa. As regards the zebra-striped Duiker, it was thought at one time that its existence on the northern borders of the Congo watershed had been discovered by Dr. Junker; but the portions of the skin of this Zebra Antelope which he obtained were in all probability part of a young form or a dwarf species of Okapi.

It has been said that the Common Hippopotamus existed in the lower reaches of the Cavally River, and was formerly found in the St. Paul's River. I saw none of them on the latter stream, and all my European correspondents deny the existence in any Liberian river (entering the Gulf of Guinea) of the big Hippopotamus, which, however, is present in the larger streams flowing towards the Niger. As regards the Dwarf Hippopotamus, it is met with in most parts of Liberia, wherever European explorers have penetrated. I have little to add to Büttikofer's description of its habits, except that I think that he insists too strongly on its predilection for a terrestrial life. According to the statements of European and native observers, it lives a good deal in the water.

The Zebra Antelope is not met with close to the coast, but is fairly abundant in the hilly regions of the interior. It would seem to be very common in the Kelipo country to the west of the upper Cavally, and also on either side of the upper St. Paul's River. The skins which I was able to exhibit came from the Kelipo country, and were collected by Mr. Maitland Pye-Smith.

Since I have mentioned the name of this collector (who has also sent me three Chimpanzee skulls and the skull and teeth of a Pygmy Hippopotamus), I might state that he forwarded me

* According to Captain d'Ollone, the Senegambian (black) Buffalo is found in Northern Liberia, the Congo or Red Buffalo in the Southern forest-region.

from the same Kelipo country, near the upper Cavally, a curious statement regarding the existence in this forest of a large black pig. The natives gave him circumstantial accounts of this pig, which is said to be five or six feet long, and he was struck by the resemblance between this story and the description first given in the 'Field' newspaper of the *Hylochœrus meinertzhageni*. At the time he wrote to me he knew nothing about the interest I had taken in the question of this giant pig of the Congo Forest, nor did he indeed know that the pig had been discovered by the Belgians in the north-eastern limits of that region. It was the first description given in the 'Field' of the discovery on the slopes of Mount Kenia which appeared to him to fit in so nearly with the stories of the natives of the Kelipo country of the pig in their country, which was of similar appearance and dimensions.

Mr. Pye-Smith also sent me native stories which he thought also indicated the existence in Eastern Liberia of a Gorilla. I mention this for what it may be worth; but the skull which was to support this theory never reached Mr. Pye-Smith, or at any rate never arrived in England. I think, myself, that some of the gorilla stories which reach the coast from the interior of Liberia are referable either to big Chimpanzees or possibly to big specimens of the Drill or Mandrill baboon. Nowhere, as yet, in Liberia have either the Drill or Mandrill baboons been found, but I should think it not improbable that they would make their appearance in the mountainous country of the far interior. I have seen only one species of baboon in this country myself. It is the common Guinea Baboon of Sierra Leone and the Gold Coast. A very common type of monkey in this country is the Sooty Mangabey, the manners and habits of which are very reminiscent of the baboons. I would point out one trick that Baboons and Mangabeys have in common, and that is the friendly greeting which they make by smacking the lips. I have never noticed this trait in any other monkey.

The Potto and at least one species of Galago are sufficiently common to have attracted the notice of the Americo-Liberians on the coast. Colobus monkeys apparently of four species are indigenous in this country; but I myself, and those who have been collecting information for me, have hitherto been able to obtain only two species—*Colobus ursinus* and *C. ferrugineus*. Büttikofer, however, seems to have obtained specimens of *Colobus polycomus* and *C. verus*. The Bay-thighed Monkey (*Cercopithecus diana ignita*) is very common.

Bats are well represented, and amongst them are prominent as regards frequency of appearance the monstrous-looking Fruit-Bats of the genus *Epomophorus*.

Among carnivorous mammals, the most interesting perhaps, from its relative rarity and its restriction to the West-African forest-region, is the Golden Cat (*Felis celidogaster*). The range of this cat has not yet been sufficiently determined, nor has a decisive opinion been passed as to the marked variations in type

which apparently can be derived from one and the same district. But for the assertions of the German authorities who have described specimens of this cat from Togoland, one would be led to suppose that the reddish-grey form with very small and faint spots on the upper parts and a somewhat small head was restricted to Senegambia, Sierra Leone, and the northern parts of Liberia; while the smoother, shorter-haired, larger-headed form, with very distinct spots and a greyer coat, extended from Eastern Liberia to the Niger Delta. (I am not aware that the existence of this cat has yet been traced to the east of the Niger, but I expect it will be found to extend to the limits of the Congo Basin.) But the Germans assert that both varieties are found concurrently. It is presumably called the Golden Cat because on the flanks, between the white of the belly and the reddish-grey of the upper parts, are bands of golden-yellow. This cat has a very savage disposition, and the closer-haired, more distinctly spotted form grows nearly to the size of a Caracal. The Serval is fairly common in the interior of Liberia. The Leopard is everywhere common, and is often much dreaded by the natives. The Lion appears to be known in the Mandingo hill-country to the north of the forest. The Spotted Hyæna is known to the Mandingos, though it is never heard of in the forest-region. The Mandingos from the interior of Liberia call the Hyæna "Djawa" or "Djani." The two words seem to exist side by side, and it is possible from the somewhat varying descriptions that both the Striped and Spotted forms may be known in the northern part of Liberia on the verge of the Niger Basin. The big Civet Cat is very abundant, so also are the Genets and the Palm-Civet (*Nandinia binotata*).

Amongst the Rodents I have noticed the African Brush-tailed Porcupine (*Atherura africana*); but Büttikofer also records the Common Porcupine as being a Liberian mammal. Mr. Whyte obtained specimens of the Graphiurus Dormouse (*Graphiurus hueti*), and also of *Anomalurus beecroftii*, the Scaly-tailed Flying Squirrel. The Black Rat is present in Liberia, and the Brown Rat has also reached that country, through the intercourse with foreign ships no doubt. The other Mice recorded are *Mus alexandrinus*, *nigricauda*, *rufinus*, *barbarus*, *trivirgatus*, *dorsalis*, and *musculoides*. The Octodont "Ground Rat," *Thryonomys*, is common. Most of the West-African Squirrels are represented, as also the genera *Cricetomys* and *Lophuromys*.

The Elephant is fairly abundant all over the interior of Liberia but has not within recent times approached nearer than about twenty miles from the coast. Usually elephants are not met with till a journey of about forty miles inland has been accomplished, and then they are so abundant as to be very dangerous to caravans, which they often attack without provocation. I have seen at Monrovia tusks of fair size. The largest that was weighed in my presence was 75 lbs. The ivory is rather curved as a rule and fairly thick. I think it will be found as a rule that the elephant of the densely forested regions in Africa has somewhat smaller

tusks than those which are developed by the males in the more open regions, where perhaps digging for roots or the desire to uproot trees is more prevalent than in the dense forest, where the elephant can find abundant sustenance in the leaves and fruits of trees which he reaches with his trunk. Extremely little is known by Europeans about the West-African Elephant, as the animal is so rarely killed in that region. I hope that some of the foresters of the Rubber Company may be able to kill a Liberian Elephant, in order to ascertain by photography, or possibly even by preserving the skin, the shape of the ears. Some little while ago it was shown by a German zoologist that an elephant received from the interior of the Cameroons had ears that were smaller and much more rounded than those of the East African type.

The Rhinoceros undoubtedly exists—I cannot say in what type—in the northern parts of Liberia, as the Mandingos at once recognised pictures of it, and named it Kôwŭrŭ. I might mention that the Mandingos talk a great deal about a striped animal which they call Siruku. They recognised a picture of a zebra and called it Siruku, but at the same time described the animal as being extremely ferocious and dangerous to life. As it is impossible to recognise this description as applying to the zebra, I thought from their gestures that they might mean the leopard; but to the leopard they gave a totally different name—Soli. Moreover, they were particular that this animal had stripes. It may be the Striped Hyæna. At the same time, on every occasion when they were shown the picture of a zebra they declared that this was the creature they called Siruku, but that in their country it was ferocious *.

As regards Antelopes, they are divisible into two groups, so far as distribution in Liberia is concerned—those that inhabit the forest and those that are confined more or less to the open, park-like country. *Cephalophus sylvicultrix* and *C. jentinki* are found in the dense forest. Most of the other Liberian Duikers, including the beautiful Zebra Antelope, are more associated with the forested hills than the lowlands; in fact, they are usually called "Mountain Deer" by the Americo-Liberians. The magnificent Bongo is fairly common. It is called the "Elk" by the Americo-Liberians, who have followed the Americans in their maddening habit of misnaming every living creature they come across; so that the Bushbuck or rather Harnessed Antelope is called the "Red-Deer," while the splendid Blue Plantain-eater is termed the "Peacock," and the Turaco, the "Redwing." Outside the forest, or on the northern verge of it, there are Hartebeests—*Bubalis major* †—

* [*Note.*—By a curious coincidence, after these lines were written I noticed the following statement on p. 293 of 'De la Côte d'Ivoire au Soudan,' by Capt. d'Ollone:—"Il me faut mentionnes . . . . . . l'existence de deux sortes d'hyènes . . . . beaucoup plus grandes plus fortes et plus hardies que celles d'Algérie ou d'Orient. Mais l'une surtout, que les indigènes appellent 'Sowara' (Cheval-panthère), serait formidable et inspire une très grande terreur. Un Sowara avait tué un sergent français dans une case peu avant notre passage. Cette hyène serait, paraîtit, tachetée."]

† Horns of this species were brought home by Col. Powney.

(which the Mandingos call Gusu), the Roan Antelope (Mandingo: Mina), and *Cobus singsing*. The Mandingos know of the Giraffe, which is no doubt present in the extreme northern part of Liberia. The Red Bush-Pig (*Potamochœrus penicillatus*) is abundant throughout Liberia. It is occasionally tamed by the natives, and is said to interbreed freely with the domestic swine. I noticed one very curious point regarding the domestic pigs which were so common an object in the streets of Americo-Liberian towns on the coast. These pigs seem to be the degenerate descendants of European breeds, introduced originally no doubt by the Portuguese, the Dutch, and the English. It occurs very frequently in the litters of these pigs that the young are striped and spotted with white, exactly like the young of the Wild Boar. I have seen it stated generally that the Domestic Pig was never marked with white like the young of the wild species of the genera *Sus* and *Potamochœrus*. Whether this feature in the domestic pigs of Liberia is caused by their reverting to the condition of the wild stock of Europe from which they sprang, or whether it is in any way due to mixture with the Red Pig, I cannot say positively; but the parents of these spotted young were emphatically European domestic pigs in origin, and did not betray in themselves the slightest intermixture with the Red Bush-Pig. But I know that on the Congo and in the Niger Delta cases of interbreeding between the Red Bush-Pig and the domestic swine are occasionally reported.

Liberia, in common with Sierra Leone and perhaps the Ivory Coast and Gold Coast, boasts of one of the most interesting of African mammals, the *Dorcatherium aquaticum*, the Water-Chevrotain. The eastern range of this animal has not yet been determined. I never remember hearing that it had been found to the east of the Gold Coast, but perhaps this is simply due to oversight. The *Dorcatherium* is fairly common in the interior of Sierra Leone, and I believe is occasionally found in Portuguese Guinea and the adjoining regions of French Senegambia. It is fairly common in Liberia, though excessively difficult to capture. It lives a good deal in the water, in which its body is often immersed. It is said by the natives to conceal itself most cleverly amongst the water vegetation. It is regarded by the people of Liberia and Sierra Leone as the embodiment of kindly wisdom. It takes the place which the hare—otherwise "Brer Rabbit"—fills in the legends of Southern and Central Africa. The natives state that three or four young are produced at a birth.

The Manatee is common in most of the big rivers; and in the forests three species of *Manis* are met with, including *Manis gigantea*. Two species of Tree-Hyrax are found in the forest, and the woodland often echoes to their weird cries.

It should be stated in a general way that the coast-regions of Liberia are exceedingly disappointing to the collector because of the remarkable absence of any form of bird or beast or even reptile. It is difficult to understand why there should be this extreme dearth, because the Americo-Liberians are not very keen about sport, nor have they any reason for desiring to

destroy birds and beasts around them. They are, on the other hand, rather kindly disposed towards these creatures. In the interior the indigenous natives have an extraordinary craving for meat, which they satisfy partly by cannibalism, but also by devouring even the skin of the creatures that they snare or shoot. On the lower part of the St. Paul's River, I have sometimes seen only one bird in the course of a whole day, and that is the very common Angola Vulture. As soon as you get into the forest the beautiful Blue Plantain-eaters (*Corythæola cristata*) become fairly common, and enliven the woods with their strange cries. Although this bird is so abundant in Liberia, very little seems to be known by the natives regarding its nesting-habits. I have received the young of *Turacus* and *Gallirex* from the nest in other parts of Africa, when the nestlings were at most four days old, and I have noticed that they were fairly well covered, except on the head, with long, fleecy, purplish-grey down. It would be very interesting to ascertain the condition of the young in *Corythæola*, as to whether they are born absolutely naked or partially covered with down. It is interesting to note that this bird alone amongst the family of the Turacos offers a marked difference in size and coloration between the male and the female. The male of *Corythæola* is at least a fourth larger than the female, and the coloration is much brighter and the crest larger. In the other members of this family there is apparently little or no difference in size or coloration between the male and female. The fine examples of *Corythæola* which have been collected by Mr. Harold Reynolds in Liberia only differ from those I have obtained in the western parts of Uganda by the blue in the male being slightly more ultramarine than the blue verditer of the Uganda specimens. Young specimens in their first year are much paler and greyer than the adults. I believe the specimens which I sent back from Uganda will establish this point. The Violaceous Plantain-eater is found in Liberia, though it is very scarce. I saw a specimen twenty-two miles inland from Monrovia, at the house of a German planter. The Turacos of Liberia seem to be *Turacus persa* and *Turacus macrorhynchus*. *T. macrorhynchus* is the common form in Liberia. The only two Guinea-fowls appear to be the rare White-necked (*Agelastes meleagrides*), and the Crested (*Guttera cristata*). The *Agelastes* is rather a small bird, with an absolutely bare red head in the male. The female or the young bird has short brownish feathers on the head, and the breast and neck seem to be only patched with white, and not wholly of that colour. The Francolins as yet recorded are *Francolinus ahantenis* (which is usually miscalled the Guinea-fowl by the Americo-Liberians) and *Francolinus lathami*. I saw no true Vultures anywhere in Liberia, the scavenging being done chiefly by the black and white Scapulated Crows. As already mentioned, the so-called Fishing-Vulture, *Gypohierax angolensis*, is common. Vultures always seem to shun the thickly forested regions of Africa, the only member of the group which in any way enters the forest-region being the *Necrosyrtes monacus*. But although

this small brown vulture is extremely common and abundant in most parts of Sierra Leone, I have never seen it anywhere on the coast of Liberia between Monrovia and Cape Palmas.

The Grey Parrot with a red tail is not indigenous to any part of Liberia. It is frequently to be met with in the houses of the natives on the coast, because it is brought there from the Gold Coast or the Congo by steamers. But the indigenous *Psittacus* is *P. timneh*, which is without the red tail, and is said not to be able to learn to talk. The grey of its plumage is browner. The tail sometimes seems to be a purple or an almost violet colour. The true Grey Parrot does not seem to make its appearance as a wild bird in West Africa until the Gold Coast is reached. This tendency towards a purple tail reappears in the variety of the true Grey Parrot which is found on the Portuguese island of Principe, in the Gulf of Guinea. Here also the plumage of the body is tending towards purple-grey, and is much darker in tone than the pale ash-grey of the ordinary type. In the western Congo and Angola, the Grey Parrot is gradually developing into a type which will be in time scarlet all over. On the island of Principe it seems to be evolving a purple form; while in the Timneh Parrot we seem to have a connecting-link between the genus *Psittacus* and the brown- grey- yellow- and green parrots of the genus *Pœocephalus*.

The Liberian Hornbills belong to the genera *Bycanistes*, *Ceratogymna*, *Lophoceros*, and *Ortholophus*. This selection includes the smallest of all the Hornbills, *Lophoceros camurus*, and the very eccentric-looking Black Hornbill and Elate Hornbill, the females of which have a bright chestnut head and neck, whilst the plumage in the same part of the males is black. Apparently the only form of *Ortholophus* which has been collected in Liberia is the smaller of the two species—*leucolophus*—in which the tips of the secondaries and primaries are not white, while there is a slight difference in the distribution of greyish-white about the cheeks. The larger and handsomer *Ortholophus albocristatus* is stated by Elliot (on, apparently, the authority of the type-specimens, supposed to have been collected by Cassin at Sierra Leone) to inhabit North-West as well as West and Central Africa (Niger, Cameroons, Congo, and Angola). Elliot remarks on the curious occurrence of *Ortholophus leucolophus* in the middle of this range, as it were, in the countries of Liberia and the Gold Coast. So far as I can ascertain, however, no specimens of *O. albocristatus* have been obtained from regions west of Lagos since Elliot's monograph on the Hornbills was written. Is it not possible, therefore, that Cassin or his collector may have made a mistake in ascribing their specimens of *albocristatus* to Sierra Leone? May they not really have been brought from much further east on the West Coast of Africa? It would be a very curious point in distribution if *albocristatus* should be found in Sierra Leone, and not re-occur again in Western Africa till the Niger was reached.

Amongst the birds collected by Mr. Reynolds on the St. Paul's

River is a little Waxbill or Weaver-bird (*Sporæginthus melpodus*), about which Mr. Reynolds makes a curious statement. He remarks that this is a very pugnacious and spiteful little bird, which does not hesitate in small flocks to attack and kill small snakes and lizards. The birds endeavour to pick out the eyes of the creature they are attacking and then to tear off its flesh in small pieces. They carry these fragments to their nests, and whilst they are rotting flies settle on them. These flies form the food, or an addition to the food, of the nestlings.

I append to this paper lists of the mammals and birds collected recently in Liberia by Mr. Alexander Whyte, Lt.-Col. Powney, Mr. Maitland Pye-Smith, and Mr. Harold Reynolds.

Appendix I.

List of Mammals collected in Liberia in 1903–4 by Mr. Alexander Whyte, Lt.-Col. Powney, Mr. Maitland Pye-Smith, and others.

Anthropopithecus troglodytes.
Colobus ursinus.
,, *ferrugineus.*
Cercopithecus büttikoferi.
,, *diana büttikoferi.*
,, *diana ignita.*
Felis serval.
,, *celidogaster.*
Viverra civetta.
Crossarchus obscurus.
Nandinia binotata.
Lutra maculicollis.
Graphiurus hueti.
Anomalurus beecrofti.
Cephalophus niger.
,, *maxwelli.*
,, *doriæ.*
Bubalis major.
Hippopotamus liberiensis.

Appendix II.

List of Birds collected in Liberia by Mr. Harold Reynolds.
By Charles Chubb, Zoological Department, British Museum.

(Mr. Reynolds' notes are placed in square brackets.)

References are given to the following papers and works which treat of the Ornithology of Liberia:—

(1) Büttikofer, J.—Zoological Researches in Liberia. A List of Birds, collected by J. Büttikofer and C. F. Sala in Western Liberia, with biological observations. Notes from the Leyden Museum, vii. pp. 129–256 (1885).

(2) Büttikofer, J. Zoological Researches in Liberia. A List of Birds, collected by Mr. F. X. Stampfli near Monrovia on the Messurado River, and on the Junk River with its tributaries. *Op. cit.* viii. pp. 243–268 (1886).
(3) ——. Zoological Researches in Liberia. A List of Birds, collected by the author and Mr. F. X. Stampfli during their last sojourn in Liberia. *Op. cit.* x. pp. 59–106, plate 5 (1888).
(4) ——. Zoological Researches in Liberia. Fourth List of Birds. *Op. cit.* xi. pp. 113–138 (1899).
(5) ——. Zoological Researches in Liberia. On a series of Birds, collected by Mr. A. T. Demery in the district of Grand Cape Mount. *Op. cit.* xii. pp. 197–206 (1890).
(6) ——. Reisebilder aus Liberia. Resultate geographischer, naturwissenchaftlicher und ethnographischer Untersuchungen während der Jahre 1879–1882 and 1886–1887. 2 vols. Leiden, 1890. 8vo. Vögel, ii. pp. 397–434, plates xxx., xxxi.
(7) ——. On a Collection of Birds sent by the late A. T. Demery from the Sulymah River (West Africa). Notes from the Leyden Museum, xiv. pp. 19–30 (1892).

1. Agelastes meleagrides.

Agelastes meleagrides Temm.; Büttik. Notes Leyd. Mus. vii. p. 230 (Soforé Place, St. Paul's River), x. p. 98 (Schieffelinsville), xi. pp. 126, 136 (Gallilee Mountain); id. Reisebilder aus Liberia, ii. pp. 424, 425, cum fig.; Grant, Cat. B. Brit. Mus. xxii. p. 374 (1893).

One adult specimen of this rare bird from St. Paul's River. [Bare skin of neck red.]

2. Guttera cristata.

Numida cristata Pall.; Büttik. Notes Leyd. Mus. vii. p. 230 (Bavia and Buluma), x. p. 98 (Hill Town), xi. pp. 125, 136 (Mount Olive); id. Reisebilder Liberia, ii. pp. 424, 425, cum fig.
Guttera cristata, Grant, Cat. B. Brit. Mus. xxii. p. 381 (1893).

No. 9. An adult bird. St. Paul's River, Dec. 27, 1904. [Bare part of neck slate-blue.]

3. Galactochrysea liberiæ.

Glareola megapoda Gray, *nom. nud.*; Büttik. Notes Leyd. Mus. vii. pp. 233, 256 (St. Paul's River, Fisherman Lake, Marfa River); id. op. cit. x. p. 99 (Fisherman Lake); id. op. cit. xi. pp. 127, 136 (Farmington River); id. Reisebilder Liberia, ii. p. 427, cum fig.
Glareola nuchalis liberiæ Schl. Notes Leyd. Mus. iii. p. 58 (1881: Liberia).
Galactochrysea liberiæ Sharpe, Cat. B. Brit. Mus. xxiv. p. 63, pl. v. fig. 1 (1894).

No. 12. Four adults. St. Paul's River, Jan. 5, 1905.

[Rock birds. Found in flocks. Wings stand out at the shoulders and do not appear to rest close at the sides as in other birds.]

4. Hagedashia hagedash.

Ibis hagedash (Lath.); Büttik. Notes Leyd. Mus. vii. p. 242 (Buluma), p. 127 (Du Queah River); id. Reisebilder Liberia, ii. p. 429.

Hagedashia hagedash Sharpe, Cat. B. Brit. Mus. xxvi. p. 19 (1898).

No. 20. ♀ adult. St. Paul's River, Jan. 27, 1905.

[Eyes red and black.]

5. Eurystomus gularis.

Eurystomus gularis Vieill.; Büttik. Notes Leyd. Mus. vii. p. 159 (Bavia and Soforé Place, St. Paul's River), xi. p. 130; id. Reisebilder Liberia, ii. p. 401; id. Notes Leyd. Mus. xiv. p. 22 (Sulymah River); Sharpe, Cat. B. Brit. Mus. xvii. p. 32 (1892).

No. 10. ♀ adult. St. Paul's River, Dec. 16, 1904.

[The so-called "Day Bat" of Liberia.]

6. Halcyon cyanoleucus.

Halcyon cyanoleuca (Vieill.); Büttik. Notes Leyd. Mus. vii. p. 162 (Bavia, St. Paul's River), xi. p. 130; id. Reisebilder Liberia, ii. p. 401.

Halcyon cyanoleucus Sharpe, Cat. B. Brit. Mus. xvii. p. 245 (1892).

No. 8. ♂ adult. St. Paul's River, Dec. 1, 1904.

[Bill bright red; eyes black. Feeds on ants. Stands on twigs with its head at right angles to its body.]

No. 11. ♂ adult. St. Paul's River, Jan. 2, 1905.

7. Lophoceros camurus.

Buceros camurus (Cass.); Büttik. Notes Leyd. Mus. vii. p. 210 (Soforé Place, St. Paul's River), viii. p. 262 (Junk River), x. p. 93 (Hill Town).

Tokus camurus Büttik. Notes Leyd. Mus. xi. p. 134; id. Reisebilder Liberia, ii. p. 419.

Lophoceros camurus Grant, Cat. B. Brit. Mus. xvii. p. 404 (1892).

No. 14. ♂ adult. St. Paul's River, Jan. 6, 1905.

[Bill very bright scarlet. Rarely met with.]

8. Scotornis climacurus.

Scotornis longicaudus (Steph.); Büttik. Notes Leyd. Mus. vii. p. 156 (near Grand Cape Mount), viii. p. 248 (Junk River), x. p. 68 (Schieffelinsville), xi. pp. 116, 129 (Gallilee Falls), xii.

p. 198 (Robertsport); id. Reisebilder Liberia, ii. p. 392; id. Notes Leyd. Mus. xiv. p. 21 (Sulymah River).

Scotornis climacurus (Vieill.); Hartert, Cat. B. Brit. Mus. xvi. p. 596 (1892).

No. 7. Two adults. St. Paul's River, Nov. 23, 1904.
["Night-birds."]

9. Corythæola cristata.

Turacus giganteus (Vieill. 1823); Büttik. Notes Leyd. Mus. vii. p. 203 (St. Paul's River and Grand Cape Mount).

Turacus cristatus (Vieill. 1816); Büttik. Notes Leyd. Mus. viii. p. 262 (Junk and Du Queah Rivers), x. p. 92 (in high forest along the Upper Du Queah River), xi. p. 134; id. Reisebilder Liberia, ii. p. 417.

Corythæola cristata Shelley, Cat. B. Brit. Mus. xix. p. 449 (1891).

No. 16. ♂ & ♀ adult. St. Paul's River, Jan. 12, 1905.
[Bill bright red and yellow. Feeds on fruit.]

10. Clamator cafer.

Coccystes cafer (Licht.); Büttik. Notes Leyd. Mus. vii. p. 225 (Bavia, St. Paul's River), xi. p. 135, xiv. p. 29 (Sulymah River); Shelley, Cat. B. Brit. Mus. xix. p. 221 (1891).

No. 19. Adult. St. Paul's River, Jan. 15, 1905.

11. Chrysococcyx cupreus.

Chrysococcyx cupreus (Bodd.); Büttik. Notes Leyd. Mus. vii. p. 225 (Monrovia), viii. p. 264 (Messurado River), xi. p. 135; id. Reisebilder Liberia, ii. p. 423.

No. 15. A ♂ immature. St. Paul's River, Jan. 7, 1905.
[Not often met with in Liberia.]

12. Ceuthmochares flavirostris.

Phœnicophaës æneus Büttik. (nec Vieill.) Notes Leyd. Mus. vii. p. 224 (Fisherman Lake), viii. p. 264 (Du Queah River).

Ceuthmochares æneus Büttik. (nec Vieill.) Notes Leyd. Mus. xi. p. 135, xii. p. 205 (Robertsport), xiv. p. 29 (Sulymah River).

Ceuthmochares flavirostris (Swains.); Shelley, Cat. B. Brit. Mus. xix. p. 401 (1891).

No. 21. Adult. St. Paul's River, Jan. 29, 1905.
[Bill yellow; iris crimson; bare skin round eyes slaty-green.]

13. Criniger verreauxi.

Criniger verreauxi Sharpe, Cat. B. Brit. Mus. vi. p. 73, pl. iv. (1881, Fantee); Büttik. Notes Leyd. Mus. x. p. 79 (Hill Town and Schieffelinsville), xi. pp. 121, 131, xii. p. 203 (Jarjee), xiv. p. 22 (Sulymah River).

No. 3. An adult. St. Paul's River, Nov. 17, 1904.

14. Pycnonotus inornatus.

Pycnonotus barbatus (Desf.); Büttik. Notes Leyd. Mus. vii. p. 180 (Buluma and Robertsport), viii. p. 256 (Messurado and Junk Rivers), x. p. 83 (common along the whole coast of Liberia), xi. pp. 122, 132 (Mount Olive), xii. p. 204 (Robertsport); id. Reisebilder Liberia, ii. p. 408; id. Notes Leyd. Mus. xiv. p. 23 (Sulymah River).

Pycnonotus barbatus inornatus Hartert, Nov. Zool. ix. p. 329 (1902, Gold Coast).

No. 6. ♂ adult. St. Paul's River, Nov. 20, 1904. "Pepper-bird."

This specimen, which was just beginning to moult, is very pale and the feathers are much worn.

15. Cisticola lateralis.

Cisticola lateralis (Fraser); Büttik. Notes Leyd. Mus. vii. p. 171 (Soforé Place, St. Paul's River), xi. p. 131; Sharpe, Cat. B. Brit. Mus. vii. p. 251 (1883).

No. 18. A ♀ adult. St. Paul's River, Jan. 14, 1905.

This specimen appears to be identical with Fraser's type which is in the British Museum.

16. Pratincola rubetra.

Pratincola rubetra (Linn.); Büttik. Notes Leyd. Mus. xiv. p. 23 (Sulymah River); Sharpe, Hand-list B. iv. p. 171 (1903).

One ♀ adult. St. Paul's River, Jan. 16, 1905.

Although it is well known that this species winters in Africa, this is only the second record from Liberia.

17. Motacilla vidua.

Motacilla vidua Sundev.; Buttik. Notes Leyd. Mus. vii. p. 173 (Bavia, St. Paul's River), x. p. 73 (Du Queah, St. John, Cess, and Sinoe Rivers), xi. pp. 122, 132 (Farmington River); id. Reisebilder Liberia, ii. p. 409.

No. 2. Two ♂ adult. St. Paul's River, Nov. 16, 1904.

18. Vidua serena.

Vidua principalis (Linn.); Buttik. Notes Leyd. Mus. vii. p. 197 (Robertsport), viii. p. 259 (Junk River), x. p. 91 (Schieffelinsville and Marshall), xi. pp. 124, 134 (Farmington, Junk, and Messurado Rivers), xii. p. 204 (Robertsport); id. Reisebilder Liberia, ii. p. 416.

Vidua serena (Linn.); Reichen. Vög. Afrikas, iii. p. 217 (1904).

No. 1. ♂ adult. St. Paul's River, Nov. 16, 1904.
No. 4. ♀ adult. St. Paul's River, Nov. 18, 1904.
No. 5. ♂ adult. St. Paul's River, Nov. 19, 1904.

19. SPERMESTES BICOLOR.

Spermestes bicolor (Fraser); Buttik. Notes Leyd. Mus. vii. p. 202 (Soforé Place, St. Paul's River), viii. p. 261 (Monrovia and Junk Rivers), x. p. 62 (Schieffelinsville), xi. pp. 125, 134 (Mount Olive), xii. p. 205 (Robertsport); Reichen. Vög. Afrikas, iii. p. 151 (1904).

No. 17. Two ♂, one ♀ adult. St. Paul's River, Jan. 13, 1905. All three specimens are in partial moult.

20. SPORÆGINTHUS MELPODUS.

Estrelda melpoda (Vieill.); Buttik. Notes Leyd. Mus. viii. p. 260 (Oldfield and Schieffelinsville), xi. p. 134; id. Reisebilder Liberia, ii. p. 417; id. Notes Leyd. Mus. xii. p. 205 (Robertsport).

Sporæginthus melpodus Sharpe, Cat. B. Brit. Mus. xiii. p. 325 (1890).

No. 13. A ♂ adult. St. Paul's River, Jan. 6, 1905.

No. 13. One ♂ and two ♀ adult. St. Paul's River, Jan. 17, 1905. Bill red. Feeds partly on grasses.

[This is a very vicious bird and has the faculty of being able (several acting in consort) to kill small snakes, first of all attacking the eyes of the snake. They then cut it into small pieces, carry them to the *nests*, where the snake rots—insects swarm on the decaying flesh, and on these insects the young birds feed. Native name "*Pessa Silisi.*"]

3. On some Abnormal Remains of the Red Deer (*Cervus elaphus*) from the Post-Pliocene Deposits of the South of England. By MARTIN A. C. HINTON*.

[Received February 15, 1905.]

The object of this communication is to place on record the discovery in various Post-Pliocene deposits in the South of England of certain remains of Deer which present characters of an abnormal nature. The specimens consist of more or less perfect frontal bones, each bearing a greater or less portion of a tyneless antler attached to a very long pedicle.

The first specimen is in the British Museum and is thus referred to in Mr. Lydekker's Catalogue:—

"*Cervus elaphus.*

"45379. Fragment of the frontal and antler of a very young individual; from the Pleistocene of Ilford. Brady Collection."

In Mr. William Davies's Catalogue of the Brady Collection is the following description of this specimen:—

"*Cervus* sp. undetermined.

"Part of a frontal bone with a long pedicle, having the basal

* Communicated by Dr. C. W. ANDREWS, F.Z.S.

portion of the antler attached; it is erect and tapering, and has no tynes; the upper portion is lost. The antler seems too robust and the pedicle too long for the pricket, or first antler of the Red Deer."

He adds that the missing portion of the antler was probably much longer than the part preserved.

The next specimen was obtained by Mr. S. H. Needham from a Pleistocene fissure-deposit in the Isle of Portland, and it is now preserved in the Museum of Practical Geology. It consists of an almost perfect left frontal with the base of the antler attached. The pedicle is long, directed upwards, outwards, and backwards, and the antler being obliquely set on the pedicle is still further directed outwards.

The last specimen to be noticed was obtained from the Holocene alluvium of Moorfields, London, and is now in the Collection of Dr. Frank Corner. It is a left frontal with the greater portion of the antler preserved. The antler and pedicle are much more erect in this than in the Portland example.

The following are the dimensions in inches of the three examples:—

	Ilford.	I. of Portland.	Moorfields.
Height of pedicle behind.........	2·1	1·82	2·16
Circumference of pedicle	3·5	3·8	3·75
" " burr	3·9	4·75	5·0
Length of antlers preserved ...	4·5	4·3	8·2

It is obvious on comparing the three specimens that they are referable to one species, and if the determination depended merely on the form of the frontal they would be referred to *C. elaphus*. The difficulty which has been felt in making this reference therefore arises in the elongation of the pedicle and in the Pricket-like tyneless antler which it supports.

Prof. Blasius, in his account* of the development of the antlers in the Red Deer, shows that immediately behind the offset of each of the principal tynes there is a "knee-bend," *i. e.* the beam above each of those points is bent convexly backwards. He then deals with some interesting cases in which the tynes have been suppressed, and I would quote the following passage as particularly bearing on the present specimens:—

"So wie an einer Stange, kann an beiden die Mittelsprosse fehlen, und nur durch die knieförmige Biegung der Hauptstange angedeutet sein; dann hätte man der Form nach einen Sechser, der jagdmässig als Gabelhirsch zählen würde. Fehlte auch die Augensprosse, *so hätte man einen Spiesser, den man der Form nach jedoch als Sechser ansprechen müsste.*"

The Moorfields antler shows on careful examination a very slight knee-bend behind and a little prominent tubercle in front at a distance of two inches from the burr; at a distance of six and

* Blasius, J. H., 'Säugethiere Deutschlands,' pp. 444–453, passage cited p. 447.

a half inches from the burr there is a second slight knee-bend. These features appear to represent the brow and middle tyne in a normal antler, and consequently this example corresponds in form to the third antler of the Red Deer in which the tynes have been suppressed. From the dimensions and appearance of the Portland specimen it may be regarded as being of the same individual age as that from Moorfields, while the example from Ilford is more probably the second antler with the brow-tyne suppressed.

In these abnormal forms there has been but little increase of weight or leverage upon the pedicle, and this has consequently found its earliest tendency to grow straightly upwards as an elongated slender cylinder but little retarded. The difference noted between the examples from Moorfields and Portland as regards direction is such as one would expect to occur if the physiological explanation suggested be the true one.

It is probable that these specimens belonged to individuals which had suffered injury to the testes at an early period of life, which resulted in making the retention of youthful characters possible for a longer period than is usually the case *. This view appears to be supported, firstly, by the fact that the animals died at a comparatively early age, their decease probably being due to their physical inferiority; secondly, by the rarity of the type, for from what we know of the ease with which much slighter variations in antlers are transmitted by heredity †, we should expect, had the possessors of such antlers had the power of propagating their species, to find their representatives in some numbers; and, lastly, by the fact that the rugose surface of the antler in the Moorfields specimen is greatly eroded and that in all the specimens there is no regular burr, which seems to indicate that these antlers were not shed annually as in sexually perfect stags.

In conclusion, I would express my best thanks to Dr. C. W. Andrews, F.G.S., Mr. E. T. Newton, F.R.S., Prof. C. Stewart, F.R.S., Mr. R. H. Burne, F.Z.S., and Dr. Frank Corner, F.G.S., for the valuable assistance which they have given me.

4. On the Affinities of the Primitive Reptile *Procolophon*.

By R. Broom, M.D., B.Sc., C.M.Z.S., Victoria College, Stellenbosch, Cape Colony.

[Received January 23, 1905.]

The affinities of few fossil reptiles have given rise to more dispute than those of *Procolophon*. When first described by Owen (1) in 1876 it was placed in the Order Theriodontia. In 1878 Seeley (2), as the result of the examination of some fresh material, regarded it as a "fossil Rhynchocephalian." In 1888 he (3) made it the type of a new suborder of the Anomodontia

* Prof. G. Rolleston, 'Scientific Papers and Addresses,' vol. ii. p. 699.
† Sir Victor Brooke, P. Z. S. 1878, p. 892.

equivalent to Pareiasauria. Cope (4) in 1889 placed it with *Palæohatteria*, *Mesosaurus*, and a number of other primitive types in the Order Proganosauria, one of the subdivisions of his group, the Theromora. Zittel (5) in 1890 put *Procolophon* in the Family Pariotichidæ in the Order Theriodontia. In the same year Lydekker (6) agreed with Seeley in placing it in a distinct Sub-order Procolophonia of the Order Anomodontia. In 1892 Seeley (7) removed it from subordinal rank, and regarded it as the type of a distinct family of the Pareiasauria, and this latter view of Seeley's has received the support of most recent writers. Two years ago I (8) expressed the opinion that *Procolophon* should be placed somewhere among the primitive Rhynchocephalians—possibly not far from *Palæohatteria*, and Osborn (9) has adopted a somewhat similar view, placing the Order Procolophonia in the Superorder Diaptosauria. Boulenger (10), the most recent writer on the subject, however, removes *Procolophon* entirely from all close relationship with the Rhynchocephalians and makes it the type of a family of the Cotylosauria, an order which he believes to be descended from the Pareiasauria.

In the past, much of the difference of opinion arose from an imperfect knowledge of the structure of *Procolophon*; at present it arises mainly from the imperfection of our knowledge of the structure of the other early reptiles to which it shows resemblances.

Within the last few years, the view that the Reptiles early divided into two distinct phyla has been steadily gaining ground and at present it has the support of the majority of workers on vertebrate palæontology. In the one branch are the mammal-like reptiles; in the other the lizard-like forms. Osborn and most of the American authorities consider that both phyla have sprung from a primitive reptilian order, the Cotylosauria; but Boulenger believes that the common ancestor was a Stegocephalian Batrachian.

If we compare an early type of the mammal-like group, *e. g.* a Therocephalian, with a generalised type of the lizard-like phylum, e. g. *Sphenodon*, we find, that though there are many differences, there are many striking resemblances, and that they have a large number of characters in common, which are not found in any Batrachian. The structure of the palate is almost identical in the two types, though quite unlike that of the Batrachian. A well-developed columella cranii is found in both Anomodonts and Rhynchocephalians and both have an occipital condyle largely formed by the basioccipital bone. The axis, atlas, and pro-atlas are essentially similar in both phyla so far as known, and both have a costo-sternum. Unfortunately we cannot study the soft parts or the ontogeny of the Anomodonts, but in the closely allied Mammals we find so very large a number of characters which are common to the typical Reptiles and are unknown among the Batrachians, that the advisability of uniting the Mammals with the Birds and Reptiles to form the Amniota is generally admitted. To account for the characters which the Mammals and Reptiles have in common, we must either assume that the characters were

developed independently in the two groups or that the groups had a common ancestor in which most of the characters were present. One or two may have originated independently, but it seems much more reasonable to assume that the two phyla sprang from an early true Reptile, than that they originated from a Batrachian and that all the characters they have in common have been developed independently.

To what order the common reptilian ancestor belonged it is difficult to say. The Cotylosauria of Cope is no doubt very primitive, but unfortunately it is very imperfectly known. The type genus on which it was founded is *Diadectes*, a form which is not very well known, and the skull of which has so far not been very satisfactorily figured. A considerable number of other genera have been placed in the order by Cope and others, some at least of which are possibly not very nearly related to *Diadectes*. *Pariotichus*, which is placed in the same order, is much better known, through the researches of Cope and, more recently, of Case. It has a skull roofed as in the Labyrinthodonts, but a palate very much like that of *Sphenodon*. But while *Pariotichus* might perhaps have been the common Amniote ancestor, so far as the skull is concerned, the condition of the shoulder-girdle shows that it is not primitive enough. It has lost the cleithrum which the ancestor must have retained. *Pareiasaurus*, though it retains the cleithrum, is further removed from the ancestral type than *Pariotichus*, but in another direction. It seems probable, however, that there were forms somewhat resembling *Pariotichus* but sufficiently primitive to have been the ancestor of *Pareiasaurus*. If such a form is discovered, then we may regard the Cotylosauria as containing the common ancestor of all reptiles.

The phylum which contains *Pareiasaurus*, *Dicynodon*, the Theriodonts, and which culminates in the Mammals, probably originated through the ancestral Cotylosaurian living in marshy regions and having to walk with the body well supported off the ground. This habit caused the ilium to become directed mainly upwards and forwards from the acetabulum, and necessitated the retention of the precoracoid. From the start once given in this direction, the evolution went on steadily till the mammal was formed.

The other phylum, which gave rise to the Lizards and Birds, was probably started by some of the early Cotylosaurians having to stalk insect prey on dry sandy or rocky places. The body rested for the most part on the ground and the legs became relatively feeble. As this was probably no very great change from the newt-like gait of the ancestor, it was long before there was much change in the structure. And some reptiles which are well advanced along the Diapsidan line, such as *Mesosaurus* or *Palæohatteria*, still retain the early types of shoulder-girdle and pelvis with very little modification. In *Palæohatteria* the now useless precoracoid ceases to be ossified, and in all the later Diapsidan types there is no trace of a precoracoid bone. The plate-like

pelvis develops into the triradiating type such as is seen in *Sphenodon*, and in all the Diapsidan reptiles with the exception of the early Diaptosaurians the pelvis is a modification of this triradiating type.

There probably were in Permian times large numbers of lizard-like reptiles which retained the roofed temporal region even after the shoulder-girdle and pelvis had become specialised, as it would be impossible to derive the Plesiosaurs and the Ichthyosaurs from two arched forms; and the Chelonians have evidently been specialised from a form which never had temporal arches at all, and yet had the *Sphenodon* type of shoulder-girdle and pelvis.

The question then arises, are we to regard such reptiles as Cotylosaurians, or are we, in consideration of the fact that they are distinctly specialised along the Diapsidan line, to put them among the Diaptosaurians, as has been done by Osborn? It is the same question as arises in connection with the classification of many groups of extinct forms; and I am inclined to agree with Osborn in placing in one group the whole phylum which has become specialised along one line, even though the early forms resemble the generalised members of the ancestral order more than they do the terminal forms.

When we consider *Procolophon*, we find that while it bears considerable resemblance to *Pariotichus*, and even some resemblance to *Pareiasaurus*, it nevertheless seems distinctly specialised along the line which gave rise to *Sphenodon*. It still retains the roofed temporal region, the precoracoid, and the plate-like pelvis, but it resembles *Sphenodon* in the arrangement of the bones of the temporal region, in the structure of the palate, in the structure and arrangement of the bones of the lower jaw, in having the teeth anchylosed to the bone, in the possession of intercentra, of which the anterior are paired as in the young *Sphenodon*, in having a well-developed plastron of abdominal riblets, and in the very close agreement of the structure of the carpus, tarsus, and phalanges.

The bones of the temporal region have been variously identified by different authorities, and unless the squamosal is rightly determined, the other bones cannot be understood. The squamosal must be the bone that is the homologue of the mammalian squamosal, which, when we trace down among the Theriodonts and Anomodonts, we find to be the bone which supports the quadrate, and is itself supported by the parietal. When two bones are present in the temporal region, it is found to be always the inner which fulfils the condition—*prosquamosal* being, perhaps, the best name for the outer. In *Procolophon* the bone which seems to be undoubtedly squamosal is the one immediately above the quadrato-jugal, and this is the one which has been regarded as squamosal by Seeley and Osborn. This bone supports the quadrate as in *Sphenodon*, and is itself fixed to the parietal. The upper and outer bone, which is regarded by Dr. A. S. Woodward (**11**) as the squamosal, has no connection with the quadrate,

and is only a roofing scale of bone. It is probably the homologue of the bone usually called "epiotic" in Stegocephalians, but it is evidently a membrane-bone and not developed from the auditory capsule, and hence not a true epiotic. A similar bone is found in *Pariotichus*, but is lost in all the higher forms. If we omit from consideration this so-called epiotic, we find the parietal, post-orbital, squamosal, jugal, quadrato-jugal, and quadrate bones having exactly similar relations to each other in *Procolophon* and *Sphenodon*, the chief difference being that there are two fenestræ in the latter form.

The condition of the teeth I do not look upon as a character of much importance in the matter of broad classification, but the teeth in *Procolophon* are by no means thecodont in the ordinary sense. Owen, in 1876, rightly stated that "the base of the tooth seems to be confluent with the osseous substance of the jaw"; and Lydekker, in 1890, stated that the marginal teeth are "completely anchylosed to the bone." Most likely in the young condition the teeth developed in sockets, but in the adult they must be regarded as much more acrodont than thecodont.

Boulenger states that "the thecodont dentition, the absence or great reduction of the plastral bones, and especially the presence of ossified precoracoids, are characters which are opposed to the association of the Procolophonia with the Rhynchocephalia." But, as has just been mentioned, the teeth cannot be regarded as thecodont, being nearly as typically acrodont as in *Sphenodon*; the plastral bones are quite as well developed in *Procolophon* as in most Rhynchocephalians; and the presence of ossified precoracoids in *Procolophon* cannot be urged as a reason for removing it from association with the ancestral Rhynchocephalians, since the early Rhynchocephalians must have had ossified precoracoids, if the Pelycosaurians are descended from them, as is believed by Boulenger. If *Procolophon* is to be removed from a position near the ancestral Rhynchocephalians and placed near *Pareiasaurus*, it must be for other reasons than those advanced by Boulenger.

Some additional evidence in favour of placing *Procolophon* in the Diaptosauria, or at least among the ancestral Diapsidan reptiles, is to be found in the striking resemblance which it bears in many points of structure to *Mesosaurus*. Unfortunately, the skull of *Mesosaurus* is imperfectly known, but all the parts of the skeleton that can be compared are fairly similar to those in *Procolophon*. There is an ossified precoracoid, anchylosed, however, to the coracoid and scapula, and the pubis and ischium closely resemble those of *Procolophon*. Though the carpus is imperfectly ossified, there can be little doubt, when that of *Stereosternum* is considered, that it has been modified from a *Procolophon*-like type. The tarsus is almost identical in structure with that of *Procolophon*—the intermedium uniting similarly with the tibiale, and a foramen being formed between the conjoined bone and the fibulare. The plastron is closely similar in the two forms. I have recently tried to show (Trans. S. Afr. Phil. Soc.

1904) that *Mesosaurus* is not a Plesiosaur, mainly because the Plesiosaurs seem to have sprung from a land ancestor which had lost its precoracoid and had the *Sphenodon* type of pelvis, whereas *Mesosaurus* has evidently sprung from a land-form which retained its precoracoid and had a plate-like pelvis. As *Mesosaurus* lived in Lower Permian times, it is evident that true reptiles of the Diapsidan phylum existed at a very early period. Only a few of them have so far been discovered, and at present we can only imagine what the structure of many of the early forms was like from what we know of the specialised descendants. *Procolophon* I believe to be a slightly modified descendant of one of the early Permian Diapsidan types such as that which gave rise to *Mesosaurus*. The beds in which *Procolophon* occurs are either Middle or Lower Triassic, but there is reason to believe that *Saurosternon* is an allied form, and this occurs in beds which are most probably Upper Permian. So that the Procolophonia probably originated in Permian times. The beds in which *Telerpeton* occurs in Scotland are considerably younger than the *Procolophon*-beds of S. Africa, being probably Upper Triassic, Rhætic, or possibly even Liassic.

I hope shortly to give a complete account of the structure of *Procolophon*, and it is to be desired that one of the American workers will do the same for one or other of the Cotylosaurians. We shall then be in a position to realise more clearly what are the relationships of these primitive types to each other.

More important Literature.

1. Owen, R.—Catalogue of the Fossil Reptiles of S. Africa. London, 1876.
2. Seeley, H. G.—"On new Species of *Procolophon*, &c." Q. J. G. S. vol. xxxiv. 1878.
3. Seeley, H. G.—"On *Pareiasaurus bombidens* (Owen), &c." Proc. Roy. Soc. 1888.
4. Cope, E. D.—"On the Homologies of some of the Cranial Bones of the Reptilia, &c." P. A. A. A. S. xix. p. 13.
5. Zittel, K. v.—Handbuch der Palæontologie. Vol. iii.
6. Lydekker, R.—Catalogue of the Fossil Reptilia and Amphibia in the British Museum. Pt. iv. London, 1890.
7. Seeley, H. G.—"Further Observations on *Pareiasaurus*." Phil. Trans. 1892.
8. Broom, R.—"On the Remains of *Procolophon* in the Albany Museum." Rec. Alb. Mus. vol. i. no. 1 (1903).
9. Osborn, H. F.—"The Reptilian Subclasses Diapsida and Synapsida, &c." Mem. Amer. Mus. Nat. Hist. 1903.
10. Boulenger, G. A.—"On the Characters and Affinities of the Triassic Reptile *Telerpeton elginense*." P. Z. S. 1904, vol. i. pt. 2.
11. Woodward, A. S.—Outlines of Vertebrate Palæontology. 1898.

5. On the Primitive Reptile *Procolophon*.

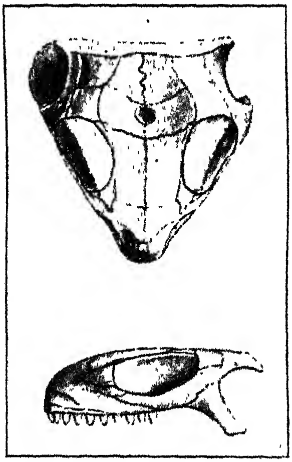
By H. G. Seeley, F.R.S., F.Z.S.

[Received March 21, 1905.]

(Text-figures 30–38.)

The Types of Procolophon.—The two specimens on which Sir R. Owen founded the genus *Procolophon* in 1876 are in the British Museum of Natural History. The author was uncertain as to the value of the characters in which *P. minor* differs from *P. trigoniceps*, intimating that it may be a young example of that species. The skulls seem to differ in their proportions (text-figs. 30 and 31). *P. minor* (text-fig. 30) is relatively broader, having the width to length of the skull as 5 to 4. In *P. minor* the orbits are more distinctly ovate, and placed further forward, being in the middle

Text-fig. 30.



Type specimen of *Procolophon minor*, from Donnybrook [the sutures are not so distinct in the specimen as in the figure].

third of the length of the head, in advance of the parietal foramen and scarcely extending behind the lateral borders of the frontal bones; the region in advance of the orbits is relatively short; the quadrate has no expansion backward as in other specimens; there is no trace of a foramen in the malar arch. Neither fossil gives conclusive evidence of the form of the teeth. Though they are in both types described as conical and pointed, it is not possible to determine the form of the crown when the jaws are closed, as is

evident in *Trirachodon* and other genera. The differences between the two specimens may be found to justify generic separation.

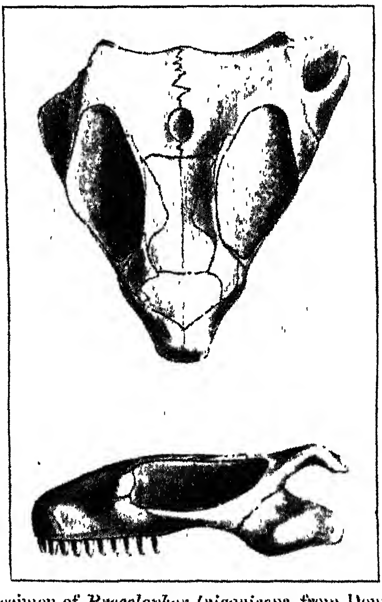
The Quadrate Bone.—The most striking difference is in the character of the bone which articulates with the mandible (text-figs. 30, 31). In *P. minor* the quadrate bone is partly imbedded in matrix, so that there is no reason to suppose that any structure is lost from that region. The quadrate bone is directed downward and backward, is compressed from front to back, forms a transverse articulation, somewhat constricted in the middle, and is thickened on the lateral external surface above the articulation ; but the bone shows no indication of the posterior development which was named squamosal by Sir R. Owen, and afterward regarded as probably quadrato-jugal by myself, which is so well developed in *P. trigoniceps* (text-fig. 31). A fresh examination of these and other skulls leads me to remark that the place of the quadrato-jugal bone is between the malar bone and the quadrate, but there is no ossification in that position in *Procolophon*. Therefore I infer that the quadrato-jugal bone has no existence in *Procolophon*. The thick cellular bone which extends from the jugal behind the articulation I am unable to separate from the quadrate bone, which articulates with the mandible, since no specimen shows a dividing suture between it and the bone which articulates with the mandible. This determination, if sustained, removes the anomaly of the quadrato-jugal attaining an enormous thickness. Its supposed position behind the malar and external to the quadrate was paralleled by the thin quadrato-jugal in *Ichthyosaurus*.

The Parietal Region.—The region behind the frontal bones and orbits, which is commonly termed parietal, shows faint obscure markings in *P. minor* (text-fig. 30) of lines in a transverse curve from the bone named epiotic to the hinder border of the parietal foramen, and short longitudinal lines prolonging the inner and outer borders of the orbits backward. The latter led me formerly to suppose that the postfrontal occupies a quadrate area in front of the epiotic extending forward to the orbit. The only other specimen in which the parietal region appears to be divided in similar way by faint markings is the British Museum skull R. 1999. The parietal bone is composite in *Mochlorhinus* and other genera. But while the appearances in *Procolophon* may be due to squamous overlap of bones, the evidence is insufficient to establish their nature, though it strongly suggests the structure in some Labyrinthodont skulls.

The Postsquamosal Bone.—The bone which is found at the posterior external angle of the flat parietal region I have formerly referred to as the epiotic. It corresponds in position with the bone so named in Labyrinthodonts, though, as most writers on Labyrinthodonts have remarked, it has nothing in common with the otic bone named epiotic by T. H. Huxley. This ossification is named squamosal by Dr. A. S. Woodward in his 'Vertebrate Palæontology,' but it is a thin plate of bone, quite distinct from the squamosal and superimposed upon it. If the

markings already referred to, which appear to indicate a posterior division of the parietal bones, really indicate bones, they would represent the pair of ossifications termed supraoccipital in Labyrinthodonts, over which the parietal bones may extend. *Procolophon* may thus far be crypto-Labyrinthodont in the structure of this part of the head. In *Pareiasaurus* there appears to be a narrow bone behind the parietal bones (Phil. Trans. Royal Soc. 1888, p. 69) and also a pair of bones behind the squamosals, postsquamosal bones as they may be named, which are in the position of the bones previously termed epiotic. The preservation in *Pareiasaurus* of this region of the skull leaves much to be desired, but it suggests comparison with *Procolophon*.

Text-fig. 31.



Type specimen of *Procolophon trigoniceps*, from Donnybrook. For comparison with *P. minor*.

The Postorbital bar.—The preservation of the type of *Procolophon trigoniceps* (text-fig. 31) is not quite satisfactory, owing to cranial bones having scaled off from the frontal region and the postorbital area on the right side. On the left side there appears to be a slight, almost imperceptible linear separation between the postorbital and the squamosal and quadrate bones. It might pass as a condition of fossilization, since it is absent in *P. minor*, but for the circumstance that the condition becomes a foramen in *P. laticeps* (text-fig. 32). There is no trace of the slit on the right side of the skull. There the sutural lines indicate a long narrow strip of bone descending

below the postsquamosal above, and between the squamosal and quadrate bones behind it and the postorbital in front, so that the space between the bones, which might be occupied by the supratemporal, has only a linear extension on the external surface, above the malar. The internal suture which separates a supratemporal from the squamosal is not clear in specimens of other species.

The Postfrontal.—One of the most characteristic features of *Procolophon* is the small size of the postfrontal bone, which is a narrow strip above the orbit external to the parietal and frontal, contrasting with the relatively large size of the prefrontal bone. There is an appearance of the prefrontal and postfrontal both underlapping the frontal bones in *P. trigoniceps*, but the preservation is dissimilar on the right and left side of the head, and the evidence is not conclusive that the postfrontal is larger than it appears to be. This character is in marked contrast to the condition in Dicynodontia and Theriodontia, in which the postfrontal not only contributes to the bar which divides the orbit from the temporal vacuity, but is prolonged backward on the temporal vacuity along the bevelled margin of the parietal bone.

I conclude, from detailed comparison of these structures and from measurements, that the type species are founded upon characters which clearly distinguish them. Other evidence shows unexpected variation in the skulls *of Procolophon*.

In 1878 I described additional material also from Donnybrook, and discussed the affinities of the genus with *Hatteria* and Anomodont reptiles. Three species appeared to be indicated by as many specimens, and were described under the names *P. griersoni*, *P. laticeps*, and *P. cuneiceps*, and figured in pl. xxxii. Quarterly Journal Geol. Soc. vol. xxxiv. The matrix was afterwards further removed from these fossils, chiefly in the endeavour to elucidate the back of the skull and the quadrate region. The published figures, which are somewhat rough, are chiefly directed to show external variations of form, and the divided nares. Beyond correcting the identification of the postfrontal bone in the way already indicated in the evidence figured in 1889 (Phil. Trans. Roy. Soc. B. pl. 19), and omitting the quadrato-jugal bone, I have nothing to modify in those descriptions; but better specimens would be required to prove that the characters in which they differ are constant.

The Occipital Region.—Although all these types were developed to display the occipital region, it was only found in *Procolophon laticeps*. The transverse, slightly concave occipital border of the roof of the skull, formed by the parietal bones and postsquamosal bones at the outer angles (text-fig. 31), extends backward as a ledge beyond the nearly vertical occipital aspect of the skull, which it slightly overhangs. The ledge is inclined downward, and terminates in a sharp edge, which at the outer angles curves down with the postsquamosal to form an arch above the auditory notch behind the squamosal bone (text-fig. 32).

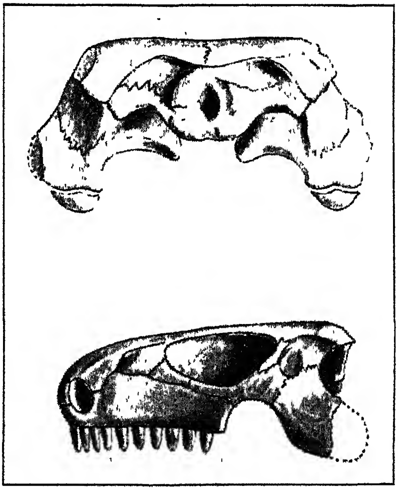
Quadrato-squamosal Arch.—The squamosal bone, which occupies a small area on the lateral aspect of the skull between the postsquamosal above and the quadrate bone below, is better seen on the occipital aspect (text-fig. 32), where it forms the upper and narrower part of the quadrato-squamosal pedicle for articulation with the mandible. The pedicle is nearly vertical, being inclined slightly backward as it extends downward, is convex on the straight side, and concave on the outer part, where the portion regarded hitherto as the quadrato-jugal is prolonged behind this surface outward and backward. The posterior aspect of the pedicle is crossed obliquely in its middle part by the sagittate suture which divides the squamosal bone from the quadrate, so that, passing downward and inward, it does not reach the mandibular articulation, which is formed by the quadrate bone. The height to the roof of the skull is $\frac{8}{10}$ inch. The transverse width of the quadrate bone at the articulation is about half an inch. This is exclusive of the great internal process of quadrate contour which extends inward and forward above the infra-quadrate process of the pterygoid bone, and internal to the descending process of the squamosal, and is exposed in one skull by removing the occipital bones.

The occipital surface of the skull, properly so called, is entirely behind the squamoso-quadrate region. Its vertical measurement is about half an inch, and the transverse width about an inch and a quarter. Below the postsquamosal bones its contour inclines to be transversely fusiform, owing to the inferior median basioccipital convexity and the lateral concave inferior emargination below the opisthotic bones (text-fig. 32).

The foramen magnum occupies the middle of the area. It is higher than wide, wider below than above, margined laterally by an elevated rounded border, such as might possibly have carried a pro-atlas. Inferiorly this border merges in the occipital condyles, which are defined by a median concavity. The sutures are not distinct, but the basioccipital appears to enter into this median concavity, so that the two condyles from which the bony tissue has been rubbed are upon the exoccipital bones. Above the condyles a transverse horizontal suture separates the exoccipital from the supraoccipital bones, which are larger. Externally these bones are limited by a vertical suture, which separates them from the opisthotic, which is subtriangular and terminates outward in a blunt process below the postsquamosal and slightly in advance of it. There may be an interparietal above the supraoccipital bones and below the parietal. The flattened surfaces of these bones appear a little concave, owing to the elevation of the border of the foramen magnum. The distinctive character of this region is the closed occiput, which is more like that of *Crocodilus* than *Testudo*, and if the quadrate bones of a Crocodile were directed downward instead of backward, the occipital region of the skull would be more closely comparable with *Procolophon* in its backward extension and elevation above the mandibular articulation. The only South African reptile which approximates to this

relation of the occipital and quadrate regions is *Pareiasaurus*; but the large lateral perforations in the occiput and single condyle for the occipital articulation prevent close comparison with *Procolophon*. There is a similar approximation to the condition in some Labyrinthodonts in this relation of the two parts of the occipital region, but in most of those types the occipital plate inclines obliquely forward, and is not comparable in the details of structure of the skull. In no Dicynodon or Theriodont is there any approximation to *Procolophon* in this region of the skull, except in the occipital plate being usually imperforate.

Text-fig. 32.



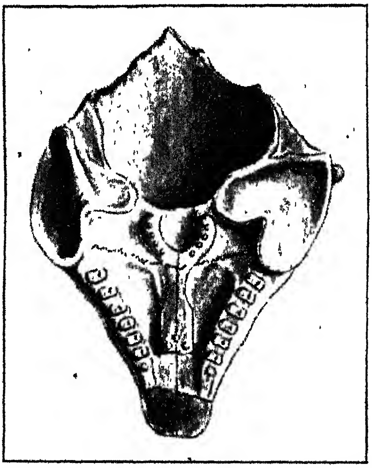
Type specimen of *Procolophon laticeps*, from Donnybrook, showing (*a*) the vertical occipital plate and (*b*) the postorbital foramen.

The specimen figured in 1889 (Phil. Trans. pl. 9) as *Procolophon trigoniceps* was thus identified, as I now think, in error, because the matrix was not then removed from *P. laticeps*. From its excellent preservation Dr. Exton's fossil has been referred to as the type of *Procolophon*. That skull is exceptional in showing a distinct lateral postorbital foramen between the squamosal, postorbital, and malar bones. When originally described, the vacuity was regarded as being in the position of the supra-temporal bone, which was supposed to have disappeared as in Crocodiles, leaving a postorbital vacuity. Dr. Smith Woodward speaks of it (Verteb. Palæont. p. 148) as evidently the beginning of a lateral temporal vacuity, and this view is adopted by Prof. Osborn (Mem. Amer. Mus. vol. viii. p. 480). Whatever may be the value of the character, it is absent from Owen's types, as already remarked. It is only found among described species in *P. laticeps*,

where the foramen is distinct, ovate, and larger (on the left side of the head), and is between the malar, postorbital, squamosal, and quadrate. It is a linear gap in the bones in one specimen. It is much smaller than the vacuity in the side of the skull in *Palæohatteria*. The extension of the foramen downward to the quadrate bone involves no substantial difference from the British Museum specimen R. 1999, so that the name *Procolophon laticeps* may be used for that specimen, in preference to *P. trigoniceps* used in Phil. Trans. 1889, pl. 9.

The Teeth.—Usually the mandible is in close contact with the skull, so that the teeth are not seen, except on their external or internal aspects. The incisors are rather longer and stouter in aspect than the maxillary or molar teeth. They are conical, but flattened on the inner surface, which carries a few vertical ridges. I have failed to obtain evidence of implantation in sockets by making a vertical section.

Text-fig. 33.



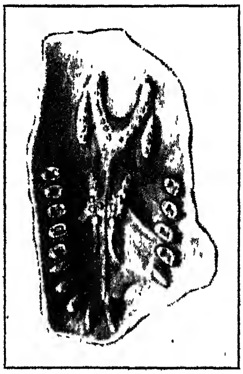
Palate of *Procolophon cuneiceps*, showing the molar teeth; from Donnybrook.

A specimen in the British Museum, R. 794, was developed in fruitless search for the occiput, but now shows with exceptional clearness the structure of the quadrate region and the palate (text-fig. 33). The pterygoids and vomera are shown bearing teeth, the palatine bones, palatine plates of the maxillary bones, and the maxillary are seen on the palate. The most interesting feature of the dentition is the crowns of the maxillary teeth, which unexpectedly have a transverse molar form, as in the lizard *Tejus*. They are six in number on each side, wide transversely, with distinct inner and outer cusps, and with the inner and outer triturating surfaces separated by interspaces which appear to have received

the molar teeth of the mandible, which have not yet been examined. All the teeth contain large pulp-cavities, which extend into the cusps of the crowns. This type of dentition, notwithstanding the suppression of the functional canine teeth, as in *Microgomphodon*, is perhaps more like that of existing lizards than of Theriodonts, though there is a distinct resemblance to the teeth of some South-African Theriodont fossils, and the skull as a whole is not Lacertilian.

Forms of Skull.—Dr. Schönland in 1895 submitted to me a series of casts of specimens of *Procolophon* in the Albany Museum, Grahamstown, obtained by Messrs. A. E. and H. Trollip, of Fernrocks. He subsequently brought the original specimens to the British Museum, and gave me the opportunity of taking a series of impressions of the more important of them. Figures were prepared and the following notes drafted on these materials. A brief catalogue of the specimens was published by Dr. R. Broom, in 1903, in the 'Records of the Albany Museum,' vol. i. part 1, pp. 8–24, all the specimens being referred to *Procolophon trigoniceps*. Three specimens are figured by him. Among the casts are remains of a species of *Petrophryne*, which need to be carefully separated.

Text-fig. 34.

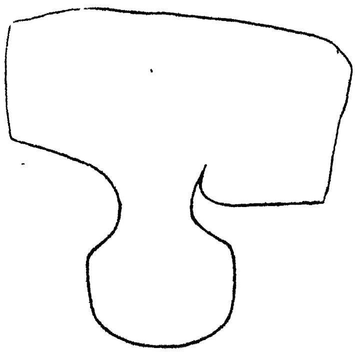


Impression of a palate of *Procolophon*, showing crowns of the molar teeth; from Fernrocks.

The Fernrocks specimens appear to be referable to different species from those collected at Donnybrook. Dr. Broom finds but three teeth in each premaxillary, and in some specimens from Donnybrook there are four premaxillary teeth. In the British Museum specimen R. 794 (text-fig. 33, p. 224), which is the only Donnybrook specimen showing the entire palate, the palatal suture between the premaxillary and maxillary bones appears to be transverse and in advance of the first pair of maxillary teeth, which are level with the small group of palatal teeth at the anterior extremity of the vomerine bones. In the Fernrocks cast of the

palate (text-fig. 34, p. 225), which Dr. Schönland numbered 1, the premaxillary bones extend backward in a wedge between the maxillary bones, so that the vomerine teeth are behind the middle of the maxillary teeth. The vomerine teeth, instead of covering the vomera as in *P. laticeps*, or forming a close-set group as in R. 794, *P. cuneiceps*, diverge backward in two rows from two strong teeth in front separated by a well-marked median groove. There are five or six teeth in each row. Internal to these are parallel shorter rows, which similarly begin with two stronger teeth in front. Further, in the Donnybrook specimen the pterygoid bones separate in an arch (text-fig. 33, p. 224) which is three-fourths of a circle, round which there is a semicircular row of small teeth. But in the Fernrocks palate this median vacuity is bordered by a pair of prominent ridges which diverge backward in a **V**-shape, each carrying six or seven teeth. These rows are flanked laterally by parallel rows of teeth, which complete the form of a letter M (text-fig. 34). The lateral rows appear to be upon the palatine bones.

Text-fig. 35.

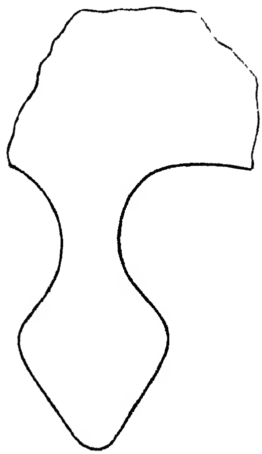


Outline showing the truncated snout of *Procolophon platyrhinus*, from Fernrocks.

The other examples of skulls which have come into my hands from Fernrocks, such as those numbered by Dr. Schönland 2, 12, 13, all differ from the Donnybrook specimens in having the preorbital region of the skull much wider and flatter above, without any indication of the tapering conical snout which is found in all the described species. This character (text-fig. 35) may be conveniently expressed in the name *Procolophon platyrhinus* for the flat-nosed species, with the region of the nasal bones forming a flattened truncated prolongation of the frontal region, with the postorbital region long and wide. A longer flat preorbital region is seen in another skull (text-fig. 36). If referable to *Procolophon*, it may be named *P. sphenorhinus*, terminating in a vertical wedge in front.

There are many differences from the types of *Procolophon* in other parts of the skeleton, which suggest that the Fernrocks specimens may belong to a different genus; and there are certainly two species from Fernrocks.

Text-fig. 36.

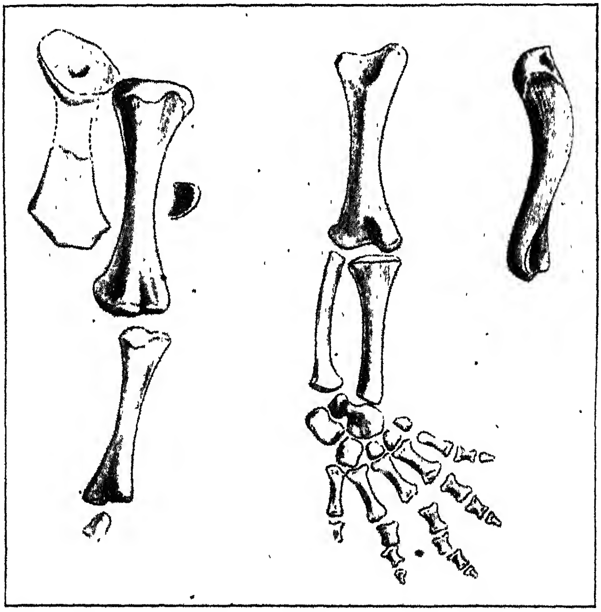


Outline showing the wedge-shaped snout of *Procolophon sphenorhinus*, from Fernrocks.

Pelvis.—The form of the ilium is partly shown in the figure of the Donnybrook skeleton. Dr. R. Broom has figured the pubes and ischia (Rec. Alb. Mus. vol. i. pl. 1. fig. 5) from Fernrocks. The evidence that those bones belong to *Procolophon* is supplied by the proximal end of the femur, which shows substantially the same characters as the specimen from Donnybrook, figured in the Phil. Trans. Royal Soc. in 1889. It is associated with dorsal vertebræ with small intercentra and a median longitudinal groove on the ventral aspect; with caudal vertebræ rounded on the ventral aspect carrying ribs which extend transversely beyond the ischia. The ilia are less clearly seen than in the original slab. The chief characters of this pelvis are the foramen perforating the pubis, the antero-posterior extension of the crest of the ilium, and the expanded forms of the short pubes and longer ischia. In form these ventral bones of the pelvic basin differ from Theriodonts like *Cynognathus* in the absence of an obturator foramen, though there is a small semicircular notch on the anterior border of a right ischium. The perforation of the pubic bone is a character of *Pareiasaurus* and of other large undescribed genera in which I have seen the bone in the South-African veldt. It also occurs in *Phocosaurus* and *Titanosuchus*. The character is not seen in *Microgomphodon*, in which the ischium is similar in form.

The bones have a general resemblance in outline to the Pliosaurian type and to some Triassic Ichthyosaurs, but in neither is the pubic bone perforated. In the Trias of Europe the nearest parallel is found, perhaps, in the Neusticosauridæ, though, according to Volz, the pubis and ischium in that type had no linear contact as in the Pareiasauria. There is a general approximation to the forms of the bones in the pelvis of *Palæohatteria*, as indicated by Dr. R. Broom, and this is as close as in *Pliosaurus*, but the pubis is notched on its hinder border, and not perforated as in *Procolophon*. The *Stereosternum tumidum* of South

Text-fig. 37.



a *b* *c*

Hind limbs of *Procolophon*, from Fernrocks.

a, femur and tibia from the front; *b*, entire hind limb, posterior aspect; *c*, side view of the femur.

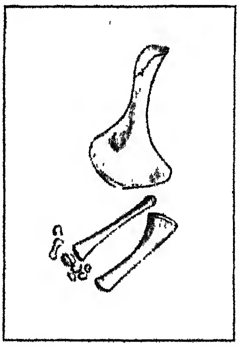
America is the only genus which exactly parallels *Procolophon* in the pelvis. It is nearer than *Mesosaurus*. Neither of these genera admits of comparison in the occipital region of the skull. But the pelvic identity of structure may justify the reception within the Procolophonia of these allied types, although they have been placed in distinct orders.

Femur.—The femur of *Procolophon* from Fernrocks is well shown

in the imperfect example which adjoins the pelvis. Its proximal end is about intermediate in form between the femur in a Chelonian and in *Ornithorhynchus*; for the under surface of the articular head is a wide concave pit (text-fig. 37, *b*), not without suggestion of the bone in *Saurodesmus* and the small mammal from Stonesfield and certain birds. The trochanters on each side of the articular head are much less developed than in the Monotreme, and the sub-articular pit is less conspicuous in the other specimens from Fern-rocks than in the Donnybrook example, which may indicate other species. The bone can best be compared with Pareiasauria. The external or posterior trochanter is produced down the shaft as a slight ridge on the under side of the bone in one specimen. The triangular section of the shaft is not so marked as in the Donnybrook specimen, and the proximal end is more flattened on the superior or anterior surface (text-fig. 37, *a*). The curvature of the bone is distinctly sigmoid in length (text-fig. 37, *c*). Distally it both thickens and widens to the articulation, where it is flat-tened on the inner side, concave behind, with a pulley articu-lation in front. One femur is longer and another shorter than the common type. There is no living reptile to which the bone approximates.

Tibia and Fibula.—The tibia is much stouter than the fibula. Its proximal end is triangular, being flattened behind, more like the tibia of a mammal than of a Dinosaur. Its wide proximal end forms the larger part of the articulation with the femur. The bone is about $\frac{6}{7}$ of the length of the femur (text-fig. 37, *b*).

Text-fig. 38.



Humerus and adjacent bones of fore limb, from Fernrocks.

The Fore Limb.—The fore limb was relatively small in the *Procolophon laticeps* (Phil. Trans. 1889, pl. 9). The humerus is considerably expanded at the proximal end, with a large radial crest, and manifestly twisted in the shaft, much as in *Aristo-desmus* and in many of the Anomodontia. But the distal end is

not exposed. Among the materials for which I am indebted to Dr. Schönland is a slab (showing no conclusive evidence of the characters of *Procolophon*) with remains of vertebræ and ribs of a young animal, in which the humerus, ulna and radius, and scattered bones of the extremity are preserved. The proximal end of the humerus is but little seen, the shaft is twisted, and the distal end of the bone expanded as in Anomodonts, with a large entepicondylar foramen, and on this side of the distal articulation the bone is rounded in contour as in Dicynodonts.

The ulna and radius are slightly shifted in position, but are parallel bones which are shorter than the humerus. I suppose the bone which is stouter proximally to be the ulna, and that the slender bone is the radius, which appears to widen distally.

Conclusion.

The evidence from all parts of the skeleton points towards similar conclusions. The skull, with its general affinity with Anomodont reptiles, comes closer to the Pareiasauria in the relation of the quadrate region to the back of the head, and closer to the Theriodonts in dentition. The shoulder-girdle is also suggestive of the Pareiasauria, but the permanent separation of all the bones and the great anterior development of the pre-coracoid are distinctive characters. There is a similar affinity in the pelvis and in the hind limb and fore limb, but the differences point in all cases to a relation with groups which have Labyrinthodont affinities. The evidence is too imperfect to justify a final determination of relationship with all the Permian and Triassic Reptilia, but it sustains the conclusion that the order Procolophonia was based upon substantial differences of this type from its allies.

April 18, 1905.

Herbert Druce, Esq., F.Z.S., Vice-President, in the Chair.

The Secretary read the following report on the additions that had been made to the Society's Menagerie in March 1905:—

The registered additions to the Society's Menagerie during the month of March were 148 in number. Of these 38 were acquired by presentation, 14 by purchase, 84 were received on deposit, 3 by exchange, and 9 were born in the Gardens. The total number of departures during the same period, by death and removals, was 130.

Amongst the additions special attention may be directed to the following:—

1. A male Eland (*Taurotragus oryx*), born in the Menagerie on March 24th

2. A male Bactrian Camal (*Camelus bactrianus*), born in the Menagerie on March 23rd.

3. A Brush-tailed Pouched Mouse (*Phascologale penicillata*) from Australia, new to the Collection, deposited on March 20th.

4. A Greater Bird of Paradise (*Paradisea apoda*) from Aru Island, and two Lesser Birds of Paradise (*P. minor*) from New Guinea, deposited on March 2nd.

5. A Black Lory (*Chalcopsittacus ater*), from New Guinea, purchased on March 2nd.

Mr. J. G. Millais, F.Z.S., exhibited the horn-core (with sheath attached) of an Urus (*Bos primigenius*). The specimen was believed to be the only British example of the actual horn of the Urus in existence. The curious corrugations on the surface of the lower end were similar to those found on the American and European Bison, and incidentally supported the view that the White Cattle at Chillingham, Chartley, and Cadzow were not descended from this animal.

Dr. W. J. Holland, F.Z.S., Director of the Carnegie Museum and Institute, Pittsburg, U.S.A., gave an account, illustrated by stereopticon slides, of the discovery of the skeleton of *Diplodocus carnegii* Hatcher, a reproduction of which he was at present installing in the Gallery of Reptiles at the British Museum (Natural History), South Kensington.

After paying tribute to the generosity of Mr. Andrew Carnegie, who had supplied the funds necessary for the extensive explorations which were being carried on by the Carnegie Institute, under his direction, Dr. Holland went on to speak of the Geology of Wyoming and of the immediate locality, where the specimen was obtained. He incidentally described the methods employed by American collectors to secure vertebrate fossils in fine condition. He then discussed the osteology of *Diplodocus*, briefly pointing out some of the more interesting structural features of the skeleton, and in this connection animadverted upon certain so-called "restorations" made public in popular magazines and emanating from artists whose artistic ability was quite in excess of their scientific knowledge.

Dr. Holland concluded his account by exhibiting in rapid succession pictures of a few of the more remarkable skeletons which had been recovered by the palæontological staff of the Carnegie Museum from various localities in the region of the Rocky Mountains.

The following papers were read:—

1. On Parts of the Skeleton of *Cetiosaurus leedsi*, a Sauropodous Dinosaur from the Oxford Clay of Peterborough. By A. Smith Woodward, LL.D., F.R.S., F.Z.S.

[Received April 14, 1905.]

(Text-figures 39–49.)

Cetiosaurus is already the best known of European Sauropodous Dinosaurs, owing to the discovery of associated limb-bones and vertebræ in the Lower Oolite near Oxford*. Much new information concerning its principal characters, however, is now afforded by a large part of a new skeleton disinterred with great skill by Mr. Alfred N. Leeds from the Oxford Clay near Peterborough. This specimen is so well preserved that, since its acquisition by the British Museum, it has been possible to mount the various bones on ironwork in their natural position. An opportunity is thus afforded for comparing *Cetiosaurus* more satisfactorily than hitherto with the better known Sauropoda of Jurassic age in North America.

The new specimen discovered by Mr. Leeds, and numbered R. 3078 in the British Museum Register (text-fig. 39, p. 233), comprises four portions of dorsal vertebræ, some neural spines of the sacrum, four anterior caudal vertebræ, a continuous series of twenty-seven middle caudal vertebræ, many chevron-bones, the right scapulo-coracoid and fore limb (lacking manus), parts of both ilia, and the left hind limb. It evidently belongs to the species which has already been named *Cetiosaurus leedsi* on the evidence of a pelvis (Brit. Mus. no. R. 1988) from the same geological formation and locality †. To the same species may also be referred four associated anterior caudal vertebræ (Brit. Mus. no. R. 1984) and a portion of the whip-like end of the tail (Brit. Mus. no. R. 1967). All these bones have the spongy texture so characteristic of the skeleton of Cetacean mammals, and the vertebral centra are therefore quite different from those of the genus *Ornithopsis*, to which the species now under consideration was originally assigned. In *Ornithopsis* the centrum of each vertebra is chambered throughout, and the thin partitions between the small cavities consist of hard, dense bone.

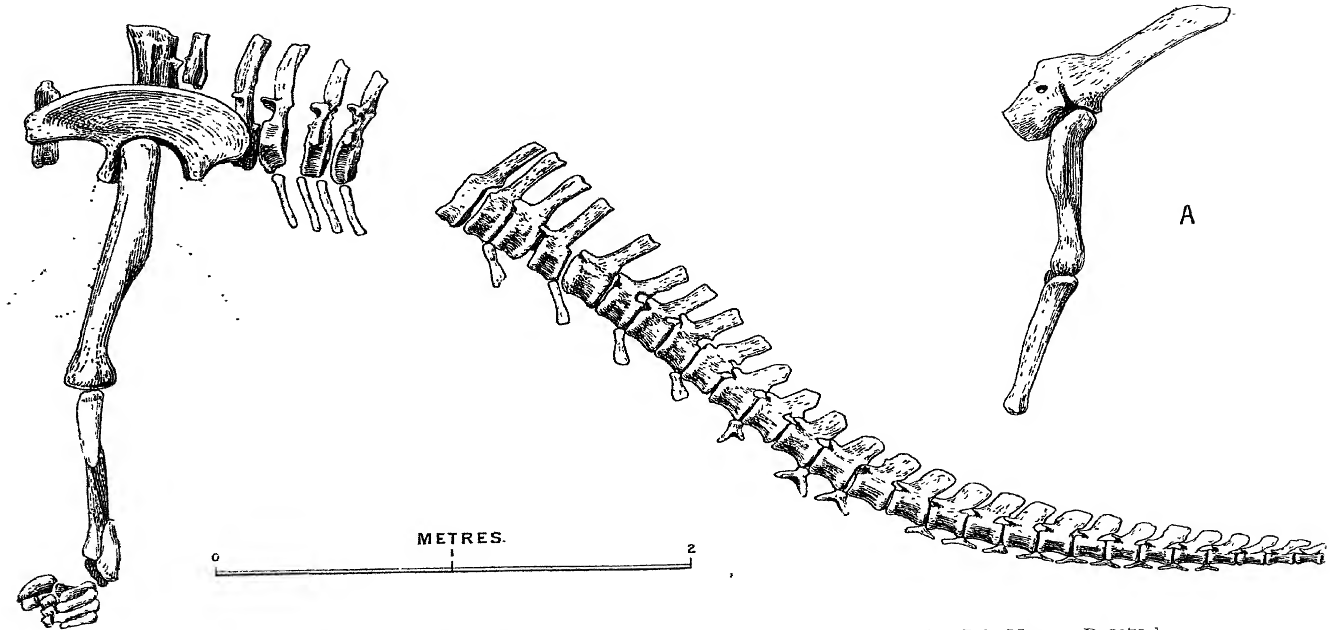
Dorsal Vertebræ.

Vertebral centra which seem to belong to the front and middle of the dorsal series are about as long as deep, and not laterally compressed though somewhat constricted. The centrum of the

* J. Phillips, 'Geology of Oxford' (1871), pp. 245–294; R. Owen, 'Monograph on the Fossil Reptilia of the Mesozoic Formations' (Palæont. Soc., 1875), pp. 27–43.

† J. W. Hulke, "Note on some Dinosaurian Remains in the Collection of A. Leeds, Esq., of Eyebury, Northamptonshire," Quart. Journ. Geol. Soc. vol. xliii. (1887) pp. 695–699. H. G. Seeley, "Note on the Pelvis of *Ornithopsis*," *loc. cit.* vol. xlv. (1889) pp. 391–396.

Text-fig. 39.



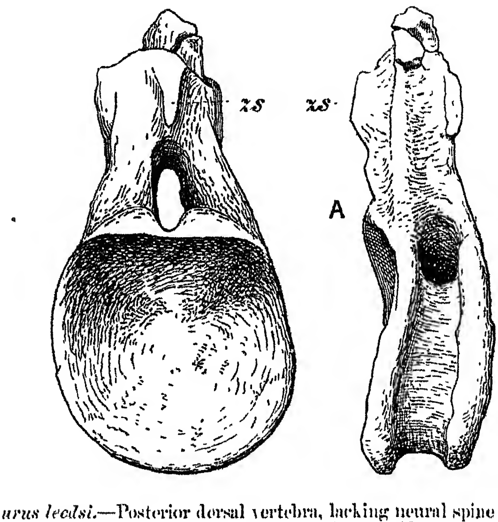
Cetiosaurus leedsi, from Upper Jurassic (Oxford Clay), Peterborough. [Leeds Collection, Brit. Mus. no. R. 3078.]

General view of tail and left hind limb, the pubis and ischium being added in dotted outline from another specimen.

A. Lateral aspect of associated fore limb (right side, but reversed in drawing). About one-thirtieth nat. size.

anterior vertebra is deeply opisthocœlous, and the anterior two-thirds of the upper half of its lateral face are impressed on each side with a shallow ovoid cavity, which has a gently rounded (not sharp-edged) margin. The centrum supposed to represent a middle dorsal vertebra is slightly smaller, and the ovoid depression in the upper half of its lateral face is more extended antero-posteriorly. Neither specimen exhibits any hollowing of the lower face. A posterior dorsal vertebra, which seems to be the last and in direct contact with the sacrum, is represented not only by its centrum but also by the greater part of the neural arch (text-fig. 40). It is remarkably shortened, the centrum being still

Text-fig. 40.



Cetiosaurus leedsi.—Posterior dorsal vertebra, lacking neural spine; posterior and (A) right lateral aspects. *zs.*, zygosphene. About ¼ nat. size.

about as wide as deep, but its length somewhat less than half the extreme diameter. This centrum is much constricted, and the shallow depression in the upper part of its lateral face disappears at the base of the neural arch. Its anterior face is not well preserved, but seems to have been slightly convex; while its posterior face is only gently and irregularly hollowed, as if it had been originally capped by cartilage. The neural canal is ovoid in section, and much deeper than wide. The deep and laterally-compressed zygosphene (*zs.*) is prominent. An isolated neural spine, which probably belongs to a dorsal vertebra, is laterally compressed and short, with a truncated and somewhat hollowed apex; there are no bony laminæ or ridges on its lateral face, but a pair of laminæ extend down its postero-lateral edges and expand below into the prominent triangular zygapophyses.

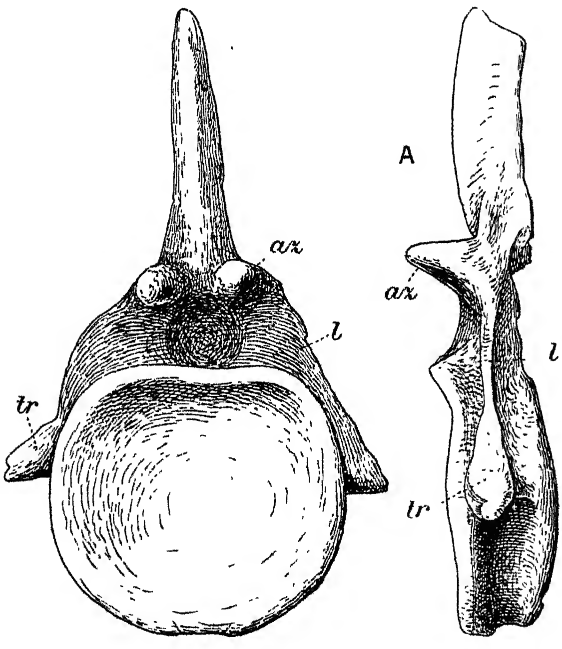
Sacrum.

The sacrum is known only by the neural spines (text-fig. 39, p. 233), of which it seems possible to identify four. Each spine is strengthened on its lateral face by an irregular vertical ridge of bone, and is sharply truncated at its upper end. Three are fused together into one plate and (from analogy with a corresponding arrangement in *Diplodocus*) may be regarded as belonging to the three anterior sacral vertebræ. The fourth spine is placed separately just behind the composite plate.

Caudal Vertebræ.

Of the four anterior caudal vertebræ preserved in the new specimen, shown in text-fig. 39, p. 233, the two foremost are too much

Text-fig. 41.



Cetiosaurus leedsi.—Anterior caudal vertebra; anterior and (A) left lateral aspects. *az.*, prezygapophyses; *l.*, broken lateral flange of bone; *tr.*, transverse process, incomplete. About $\frac{1}{8}$ nat. size.

broken to display many of their characters. As mounted, indeed, the neural spines are hypothetically ascribed to the centra beneath them. The centra are very short and slightly broader than deep, each bearing traces of transverse processes placed rather low on

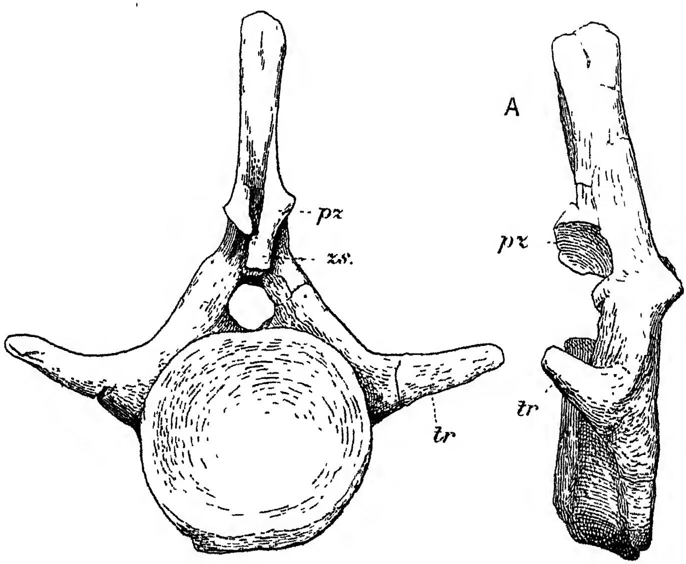
the side. The neural canal in transverse section is somewhat deeper than broad. The neural spines are laterally compressed, thinnest at their front rugose border, and hollowed at the apex; they bear no lateral ridges, but their postero-lateral edges are produced into a pair of laminæ, which gradually expand downwards into the posterior zygapophyses. The next caudal vertebra in the same specimen is probably the fourth, and is comparatively well preserved with its neural spine complete (text-fig. 41, p. 235). The centrum is concave in front, but flattened or even slightly convex behind; and it is much constricted between the prominent rims of its two faces, without any trace of lateral pits. It is slightly broader than deep, and the transverse processes (incomplete in the fossil) arise within the upper half. Each lower border is impressed by a facette for the chevron-bone, the hinder being larger than the anterior impression. The neural arch is very massive, and the neural canal is still somewhat deeper than wide. The bases of the anterior zygapophyses (*az.*) prove them to have been very stout; and a thin vertical lamina or lateral flange of bone extends downwards from the level of these zygapophyses to the transverse processes on the centrum. The neural spine is massive and placed above the hinder half of the centrum, slightly curved backwards but scarcely overlapping the next vertebra; it is laterally compressed, thinnest at its front rugose border, and somewhat hollowed and roughened at its truncated upper end. There is a slight oblique ridge extending upwards and backwards from the anterior zygapophysis on each side but soon disappearing; and the posterior lateral edges of the spine are produced into rather stout laminæ which would originally terminate below in the posterior zygapophyses. These zygapophyses evidently converged below into a short median ridge or zygosphene, which fitted into the zygantrum between the anterior zygapophyses of the succeeding vertebra. In this next vertebra part of the bony lamina above the transverse process on the left side is well preserved, while the oblique ridge above the anterior zygapophysis is comparatively strong.

The four associated anterior caudal vertebræ of another specimen (Brit. Mus. no. R. 1984) are also very short and broad, with deeply concave anterior face and nearly flat posterior face. The largest closely resembles the anterior caudals just described, and exhibits part of the lateral flange of bone which extends upwards from the transverse process to the level of the zygapophyses. The others are evidently intermediate between the most anterior and the middle caudals, and one of them is represented in text-fig. 42, p. 237. This specimen shows the complete length of the transverse processes. It has a less elevated neural arch than the vertebræ already described, and exhibits the lateral bony flange above the transverse process reduced to a slight rounded ridge.

Apart from the specimens just mentioned, the few vertebræ intermediate between the most anterior caudals and the middle caudals are unknown; but the latter are represented by a fine

continuous series of 27 vertebræ, of which only some of the foremost are defective in preservation. The first of these middle caudals is the most imperfect, and its neural spine is hypothetically fixed; but the centrum is shown to be sharply rounded below, with a distinctly double facette for the chevron behind. All these vertebræ are much more elongated than the anterior caudals, and somewhat laterally compressed; but they are still slightly constricted, without any lateral pits, while both their articular ends are a little concave. As they are traced backwards, the centra not only decrease in size but soon lose the last remnant of a transverse process; while their neural spines become shorter,

Text-fig. 42.

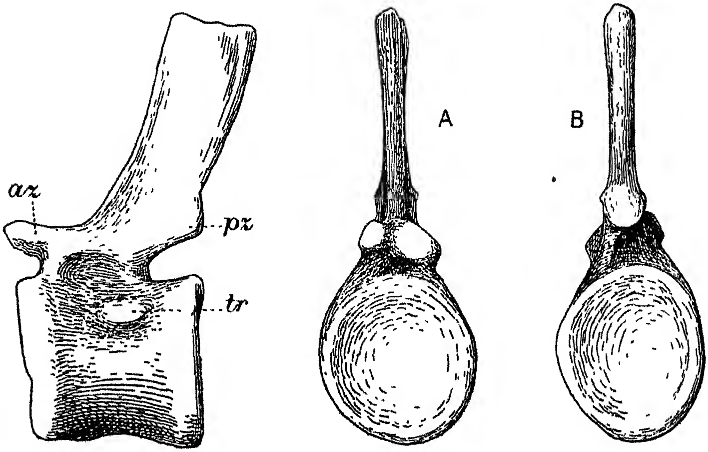


Cetiosaurus leedsi.—Anterior caudal vertebra; posterior and (A) right lateral aspects. *pz.*, postzygapophysis; *tr.*, transverse process: *zs.*, zygosphene. [Brit. Mus. no. R. 1984.] About ⅛ nat. size.

broader, and thinner, and more sharply inclined towards imbrication. The seventh vertebra of this series (text-fig. 43) is especially well preserved. The anterior face of its centrum (text-fig. 43 A) is relatively broader than its posterior face (text-fig. 43 B), and the transverse process is a mere ovate tubercle (*tr.*) on the middle of the upper part of its side. The neural spine scarcely overhangs the centrum behind, and its truncated upper end is still slightly hollowed. The prezygapophyses (*az.*) are large and clasping, but the postzygapophyses (*pz.*) are feeble, and there is no zygosphene-articulation. A large opening is left for the exit of the spinal

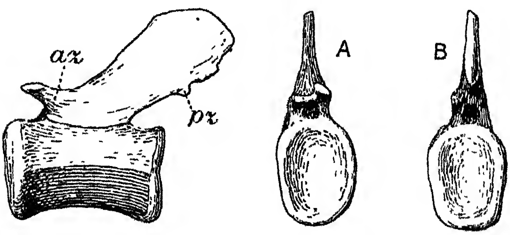
nerve. The twenty-first vertebra of the same series (text-fig. 44) is essentially similar, but more elongated, without any trace of the transverse process, and with the laminar neural spine considerably overhanging the centrum behind.

Text-fig. 43.



Cetiosaurus leedsi.—Middle caudal vertebra; left lateral, (A) anterior, and (B) posterior aspects. *az.*, prezygapophysis; *pz.*, postzygapophysis; *tr.*, transverse process. About ⅛ nat. size.

Text-fig. 44.

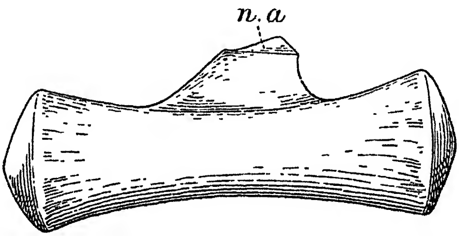


Cetiosaurus leedsi.—Posterior middle caudal vertebra; left lateral, (A) anterior, and (B) posterior aspects. *az.*, prezygapophysis; *pz.*, postzygapophysis. About ⅛ nat. size.

The last-described vertebra might well be named a posterior caudal, were it not known from American specimens of *Diplodocus* that the tail of the Sauropodous Dinosaurs was furnished with a long terminal lash. This slender appendage was certainly present in *Cetiosaurus*, for Mr. Leeds has discovered in the Oxford Clay a chain of ten small vertebræ precisely similar to the terminal

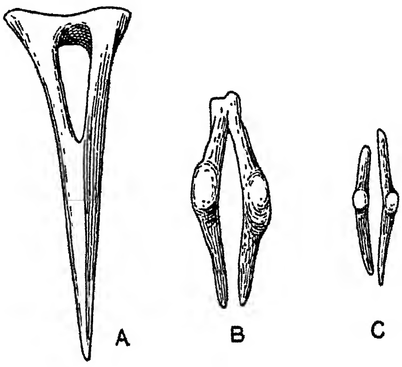
caudals of *Diplodocus*, only slightly less elongated. Each of these vertebræ (text-fig. 45) consists of a long constricted centrum with strongly convex, almost conical ends; and it bears on the middle of its upper face only a rudiment of a neural arch in the form of a pair of elongated ridges (*n.a.*) which exhibit a facette for a capping of cartilage above. A chain of such vertebræ at the end of so massive an animal as *Cetiosaurus* must have been especially liable to accident; and it is interesting to note that the short series discovered by Mr. Leeds has been broken at two points and repaired during the life of its original possessor.

Text-fig. 45.



Cetiosaurus leedsi.—One of the terminal caudal vertebræ, left lateral aspect. *n.a.*, surface for cartilaginous upper part of neural arch at summit of ossified lamina or pedicle. [Brit. Mus. no. R. 1967.] $\frac{2}{3}$ nat. size.

Text-fig. 46.



Cetiosaurus leedsi.—Chevron-bones: A, from anterior caudal vertebra, anterior aspect; B, C, from middle caudals, upper aspect.

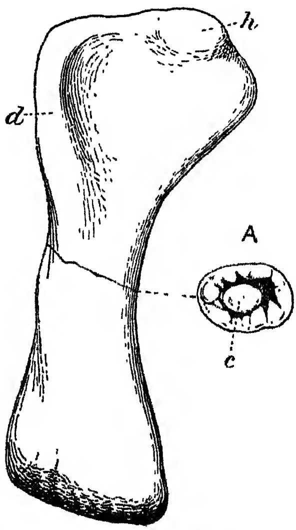
The chevron-bones are remarkable as varying much in character according to their position in the tail. Only those beneath the middle caudal vertebræ numbered 15, 16, and 17 were actually found in direct contact with the centra; but there can be no doubt

that the others as mounted (text-fig. 39, p. 233) are approximately in their natural order, each articulating with two adjoining vertebræ. Many, of course, are missing. The most anterior chevrons (text-fig. 46 A, p. 239) are normal, consisting of a pair of simple elongated laminæ, which are fused together in the long extension beneath the hæmal canal, and are united by a very slight bridge of bone at their upper articular end. Further back, the extension beneath the hæmal canal begins to shorten and widen into a triangular expansion, which ultimately becomes forked below; and the upper ends of the chevron are no longer united even by a slender bony bridge. Still further back, the forked laminæ of the two sides begin to be only partially and irregularly united in the middle line (text-fig. 46 B); while near the end of the chevron-bearing middle part of the tail the laminæ of the two sides remain quite separate, and each is forked at so wide an angle that it is practically a horizontal splint of bone which tapers to each end and is suspended by a knob at its middle (text-fig. 46 C).

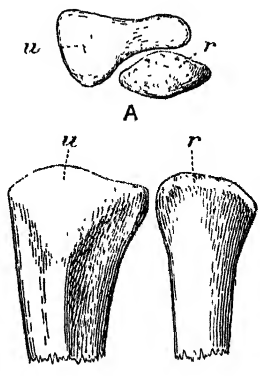
Fore Limb.

The scapula (text-fig. 39 A, p. 233) is a long and slender blade, flattened on its inner face, gently convex on its outer face, and apparently very little expanded at its distal end, which is incomplete

Text-fig. 47.



Text-fig. 48.



Text-fig. 47.—*Cetiosaurus leedsi.*—Right humerus, anterior aspect, and (A) transverse section showing internal cavity. *c.*, internal core of rock representing a cavity; *d.*, deltoid crest; *h.*, thickened head. About $\frac{1}{15}$ nat. size.

Text-fig. 48.—*Cetiosaurus leedsi.*—Upper portion of right radius (*r.*) and ulna (*u.*), anterior aspect; and (A) upper articular end of the same. About $\frac{1}{15}$ nat. size.

in the fossil at the upper border. The bone becomes thick and massive in the lower part of the proximal end, where it forms half the articular socket for the humerus; above this it expands into a thin lamina of unknown but probably small extent. The coracoid seems to have been nearly quadrangular and somewhat broader than long, though its upper edge is incomplete in the fossil. Its thin upper half is anchylosed with the proximal expansion of the scapula; but its massive lower half, which enters into the articular socket for the humerus, is separated from the scapula by a cleft, which must have been originally filled with cartilage. The bone is pierced with the usual oblique oval foramen near the middle of the border which articulates with the scapula.

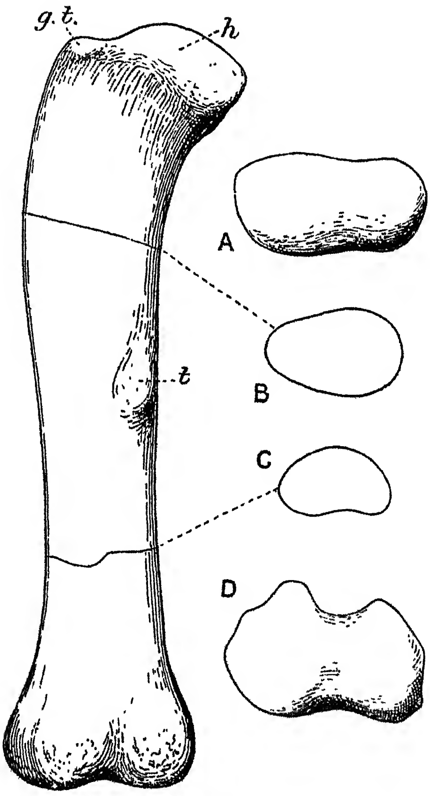
The humerus (text-fig. 47, p. 240) is complete in the fossil and scarcely crushed; but an opportune transverse fracture permits the observation that the shaft has a small cavity, perhaps an original medullary cavity, perhaps due to decay (text-fig. 47 A). As seen from the front, the bone is short and stout, with the thickened articular head near the inner end of its expanded proximal border. The deltoid crest (*d.*) is thick and prominent, not extending below the upper half of the shaft. The distal end of the bone is deeply furrowed for a cap of cartilage, and its large inner condyle bulges downwards. The ulna and radius (text-fig. 48, *u.*, *r.*, p. 240) are imperfect and much broken distally; but there is not much doubt about the accuracy of their length stated in the table on p. 243, and the shape of their upper articular end is clearly as shown in text-fig. 48. The manus is unknown.

Hind Limb.

As shown by the table of measurements on p. 243, the hind limb is considerably longer than the fore limb, the ratio being about 3 to 2. The ilium is fragmentary on both sides of the fossil, but the one bone fortunately supplements the other, and justifies the complete outline given in text-fig. 39, p. 233. This element is noteworthy for its great antero-posterior extent and the length of the slender pedicle which supports the pubis. The upper rim of the large perforated acetabulum is not very prominent. The pubis and ischium of another specimen (Brit. Mus. no. R. 1988) have already been described by Prof. Seeley, and have been added in outline to text-fig. 39. The femur (text-fig. 49, p. 242) is complete from end to end, but part of the surface of the shaft has decayed and been restored with plaster. It is a remarkably slender bone for so massive an animal, and in broken sections there is no trace of a small medullary cavity. The head of the bone (*h.*) is relatively large and curved inwards, and it rises above the level of the great trochanter (*g.t.*). The shaft is antero-posteriorly compressed, but bulges considerably backwards just above its lower half into a prominent fourth trochanter (*t.*) on the inner border. The distal condyles are about equal and well separated by a groove. The tibia and fibula are too fragmentary for description, and the

length assigned to them in text-fig. 39 (p. 233) is hypothetical. The massive triangular distal end of the tibia bears the decayed remains of the large astragalus still in direct contact, but the tarsus is otherwise lost. Most of the bones of the foot are preserved, but they were discovered in a scattered condition and have only been hypothetically arranged on the plan of the known

Text-fig. 49.



Cetiosaurus leedsi.—Left femur, posterior aspect: A, upper end; B, C, transverse sections of shaft; and D, lower end. About $\frac{1}{13}$ nat. size.

feet of *Diplodocus* and *Brontosaurus*. The innermost digit is the stoutest and its large claw is present, while the two outer toes are comparatively small. It may be regarded as certain, indeed, that *Cetiosaurus* resembles the other known Sauropoda in having an "entaxonic" foot approaching that of some of the giant Ground-Sloths—the three inner toes being well developed and clawed, the two outer toes being rudimentary.

The following table gives some of the more important measurements (in metres) of the associated bones in specimen no. R. 3078:—

Caudal Vertebræ described and figured:—

	Text-fig. 41.	Text-fig. 42.	Text-fig. 43.	Text-fig. 44.	Text-fig. 45.
Total height to summit of spine ..	0·66	0·58	0·45	0·225	0·03
Length of centrum	0·10	0·105	0·18	0·17	0·09
Max. depth of centrum, posterior end ..	0·27	0·23	0·17	0·10	0·027
Max. width „ „ „ .	0·28	0·245	0·15	0·085	0·02
Width between extremities of trans. proc.		0·535			

Fore Limb:—

Total length of scapula		0·965
Width of middle of scapula		0·175
Maximum thickness of scapula at articular end		0·165
Total length of coracoid		0·35
Probable extreme width of coracoid		0·38
Total height to top of humerus as mounted	about	2·00
Total length of humerus		0·94
Thickness of articular head of humerus		0·155
Transverse width of upper end of humerus		0·42
„ „ lower end of humerus		0·29
„ diameter of middle of humerus		0·18
Antero-posterior diameter of middle of humerus		0·135
Total length of radius and ulna		0·76
Transverse width of upper end of radius		0·185
„ „ „ ulna		0·26

Hind Limb:—

Extreme length of ilium		1·02
„ depth of ilium at pubic pedicle		0·51
Maximum diameter of acetabulum	about	0·30
Total height to top of femur as mounted	„	3·15
Total length of femur		1·36
Transverse width of upper end of femur		0·33
„ „ lower end of femur		0·33
Antero-posterior diameter of shaft of femur at 4th trochanter		0·19
„ „ „ „ below 4th trochanter		0·145
Transverse „ „ „ „		0·195

Hind Foot:—

Metatarsals	I.	II.	III.	IV.	V.
Extreme length	0·16	0·21	0·22	0·215	0·195
„ width of distal end.	0·13	0·11	0·08	0·07	0·04
„ depth of distal end.	0·07	?	?	0·05	0·075

Claw of Digit I.:

Total depth of articular end	0·125
„ width of articular end	0·06
„ length of upper curved edge	0·27

In conclusion, it is evident that the late Professor Marsh * was justified in regarding *Cetiosaurus* as one of the most generalised of known Sauropoda, closely related to the American Morosauridæ. So far as known, in fact, this English Jurassic genus is scarcely distinguishable from the least specialised American genus *Haplocanthosaurus* †, which has remarkably similar dorsal and anterior caudal vertebræ, but seems to differ in the more coarsely cancellated texture of the bone in its vertebral centra.

* O. C. Marsh, "Comparison of the Principal Forms of Dinosauria of Europe and America," Geol. Mag. [3] vol. vi. (1889) p. 205.

† J. B. Hatcher, "Osteology of *Haplocanthosaurus*," Mem. Carnegie Mus. vol. ii. no. 1 (1903).

2. On a Young Female Giraffe from Nigeria. By P. Chalmers Mitchell, M.A., D.Sc., Secretary to the Society.

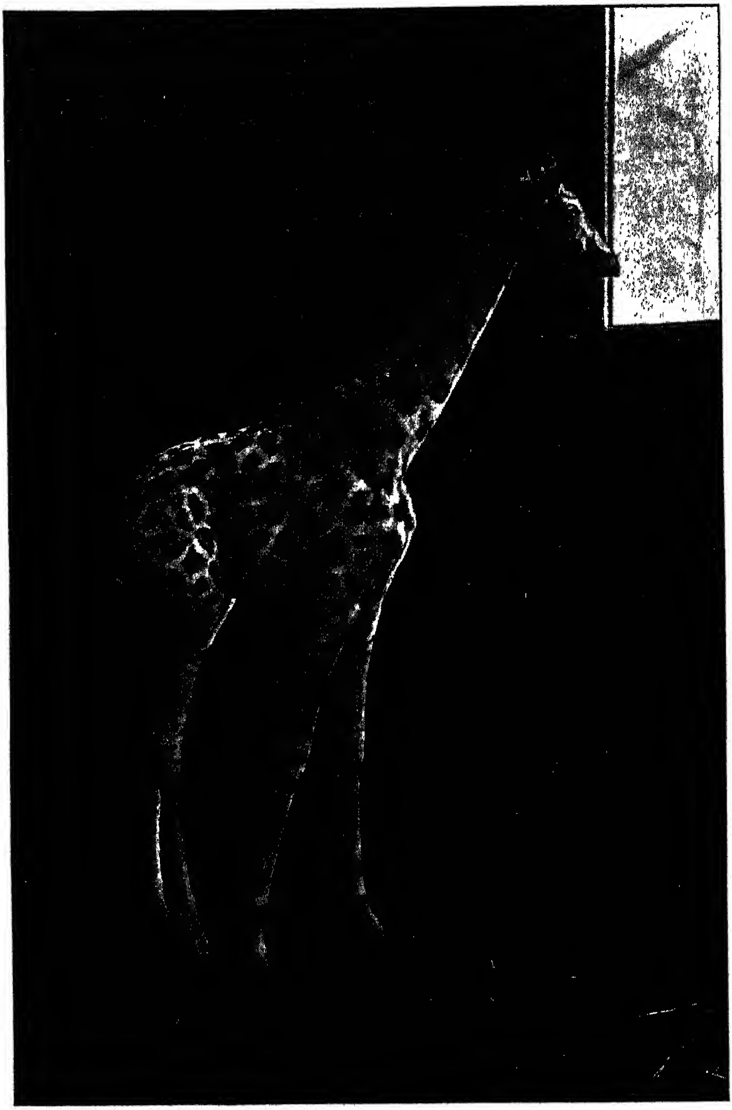
[Received April 18, 1905.]

(Text-figures 50 & 51.)

Early in April 1905 Captain H. C. B. Phillips, British Resident in Northern Nigeria, brought to London, and deposited in the Zoological Gardens, a young female Giraffe about a year old, and standing over 8 feet high, which he had obtained in Nigeria in the district of Gummel, about 300 miles due west of the south end of Lake Chad. Giraffes from Nigeria are not well known. Mr. O. Thomas (P. Z. S. 1898, p. 39) has made the skull and anterior cannon-bones of a female, obtained near the junction of the Benue and Niger rivers, some 300 miles to the south and west of the locality of Captain Phillips's specimen, the type of a subspecies, *Giraffa camelopardalis peralta*; and Mr. Lydekker (P. Z. S. 1905, vol. i. p. 119) has referred to that name the skin, skull, and limb-bones of an adult bull obtained by Captain G. B. Gosling in Nigeria, and now in the British Museum (Natural History). The head of the young female at the Gardens displays a well-marked pair of main horns covered with very dark hair at the tips, feeble swellings in the place of the occipital horns, and a protuberance, rather large in area, but very flat, in place of the frontal horn. Mr. Thomas (*loc. cit.* p. 40) laid some stress on the direction of the main horns. In Captain Phillips's young female, as in the type-specimen, these horns are divergent when viewed from the front. It appears to me, however, that in this respect there is evidence of a good deal of individual variation in Giraffes. In the fine head of the bull *G. c. peralta* mounted in the British Museum the main horns are asymmetrical, that on the left side being markedly bent in towards the middle line. In the two examples of the Kordofan Giraffe now living in the Society's Collection the condition of the main horns differs. In the female they are bent in towards the middle line; in the male they diverge slightly. So also the inclination of the plane of the horns to that of the forehead differs in individuals of the same race. So far as the shape of the head and horns goes, it would be difficult to distinguish this Nigerian Giraffe from the Nubian form.

As Mr. Lydekker (*loc. cit.* p. 120) has given a description of the coloration of the Nigerian Giraffe based on his examination of Captain Gosling's specimen, it will be sufficient if I state how far examination of the young female now at the Gardens confirms the distinctness of the Nigerian race. The young female (text-fig. 50, p. 245), like the adult bull, is much paler than the Nubian form, the paleness being especially marked on the head and thighs of the female. In the photograph, reproduced as text-fig. 50, whilst

Text-fig. 50.



Young female Giraffe from Nigeria.

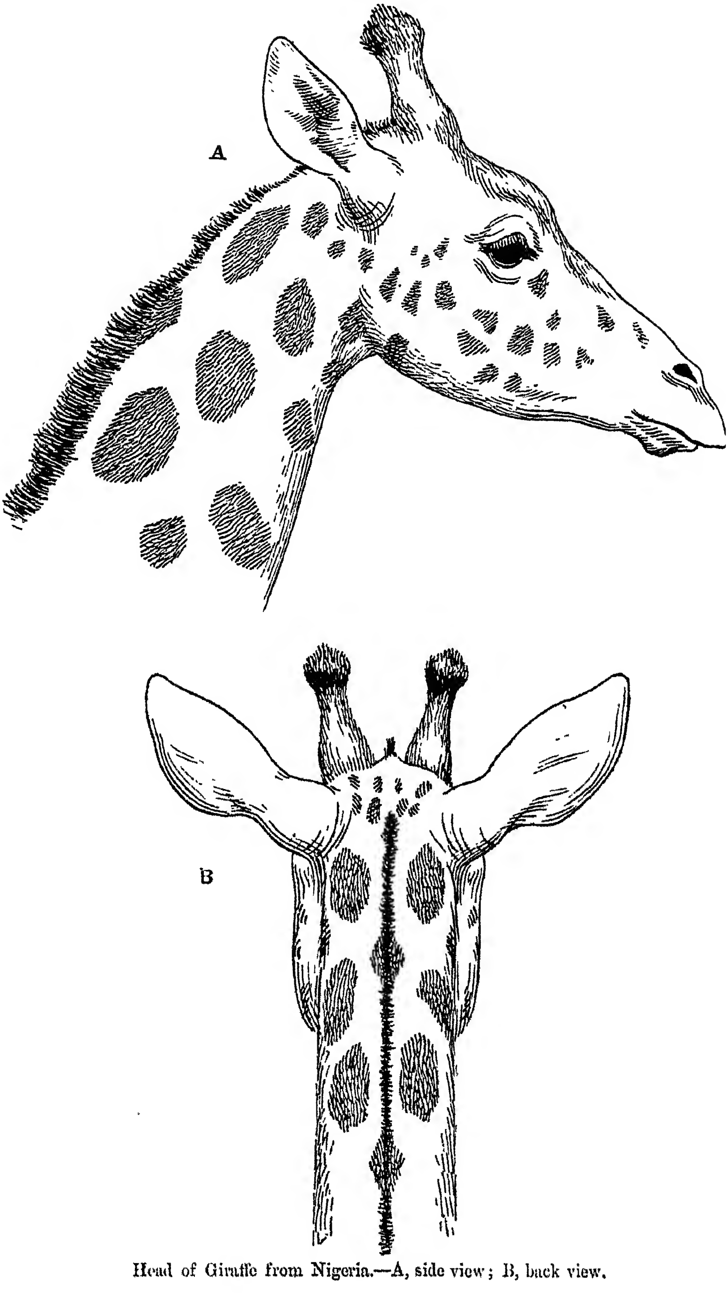
the pattern is shown brilliantly, the dark patches appear notably darker than in the living animal. The network is broad and

nearly pure white, and the lower parts of the legs, as in the northern forms generally, are white, showing only the faintest trace of spots. The middle line of the face and forehead, as in the bull, has a pale fawn band, narrower and paler than the corresponding region in the Nubian Giraffe. Between the nostrils in the bull and the young female is a dark spot, not recorded by Mr. Lydekker, and absent in the specimen of Nubian type at the Natural History Museum. The dark marks inside the pale ears are arranged in most Giraffes in three distinct pencillings. Although I have not seen this pattern called attention to, and although it is slurred over in most of the published figures, it is present in all the Giraffes that I have seen, except in the head of the Nubian Giraffe mounted in the British Museum (Natural History). In that specimen there are only two pencillings, and in the young female which is the subject of this note the arrangement is not so clearly divided into three (text-fig. 51, A) as in most Giraffes, although it does not resemble the Nubian form in this respect. It would be interesting to have more information on this point, not only with regard to other examples of the Nubian and Nigerian Giraffes, but in the cases of many other animals. In quite a large number of Antelopes, for instance, there is a trifid dark pattern inside the ear, but I do not know of any observations on this subject. Two rather regular rows of pale spots lie along the face under the eye and ear, the arrangement of these being similar in the bull and young female, and different from the irregular spots in the corresponding region of the Nubian form.

The blotches on the front of the neck of the young female differ considerably from those in the case of the bull. They are much more numerous and more regularly quadrangular, and instead of fading off into the ground-colour, they are sharply marked off from it. It is possible that in the course of growth they might come to assume the elongated shape and indefinite margins characteristic of the neck-blotches of the bull, but in their present form they differ considerably and yet do not approach more closely to the condition in the Nubian form.

Mr Lydekker has pointed out that the occipital region, the back of the head from the root of the horns to down below the ears, is marked with small spots in all Giraffes, except the Nubian, where this region is very white, and in the Nigerian, where it is white with a few fawn spots between the ears and the horns and large fawn blotches below the ears. The young female Giraffe resembles the Nigerian bull in this region (text-fig. 51, B). Judging from these two examples, it would seem as if a special character of the Nigerian Giraffe is that the characteristic large blotches of the neck are carried higher upon the back of the head, to a region which is marked by very small spots in most Giraffes, but which in the Nubian form is white with only a very few pale spots between the ears and the horns.

Text-fig. 51.



Head of Giraffe from Nigeria.—A, side view; B, back view.

The skin of the body generally is covered with numerous brown blotches, separated by rather sharp outlines from the broad white reticulum. The centres of the blotches are rather darker, but they do not show the trefoil pattern observed by Mr. Lydekker in the bull. Nor do they show the white centres conspicuous in the blotches along the sides of the Nubian male figured by Mr. Lydekker (P. Z. S. 1904, vol. i. pl. ix.). The general resemblance of the Nigerian female to the Nubian form is rather more striking than Mr. Lydekker found in the case of the male. There is no trace of the large white patch round the front of the neck where it joins the head, looking as if a white muffler had been tied round the neck and the ears, which forms so conspicuous a character in the Kordofan Giraffes (*G. c. antiquorum*) now exhibited in the Society's Collection.

I am inclined to think that the evidence afforded by this young female strengthens belief in the existence of a distinct race of Nigerian Giraffes, a race closer to the Nubian Giraffe than to any other form, but I do not think that as yet there is complete evidence for identifying this female Giraffe and Captain Gosling's bull with the *G. c. peralta* of Thomas. It is certainly important that all examples of which exact localities are known should be carefully compared with other forms.

3. Notes on Ento-Parasites from the Zoological Gardens, London, and elsewhere. By A. E. Shipley, M.A., F.R.S., Fellow and Tutor of Christ's College, Cambridge, and University Lecturer in the Morphology of the Invertebrata.

[Received February 27, 1905.]

(Text-figure 52.)

The collections on which the following notes were made came chiefly from the animals in the Society's Gardens. The new species of *Porocephalus* was, however, kindly sent me by Dr. von Linstow of Göttingen. The South-American parasites I owe to the kindness of Mr. Rosenberg, of Haverstock Hill.

TREMATODA.

Paragonimus westermani (Kerb.).

Distomum westermani Kerbert, 1878, Zool. Anz. i. p. 271; Arch. mikr. Anat. xix. 1881, p. 529.

Distoma ringeri Cobb, 1880.

Distoma pulmonale Baelz, 1883, Berl. klin. Wochschr. p. 234.

Distoma pulmonis Suga, 1883.

Mesogonimus westermani Raill. 1890.

Three specimens from the lungs of a Tiger in the Zoological Gardens.

This species was first described by Kerbert from a Royal Tiger in the Gardens at Amsterdam. He states they were found, two at a time, in pockets in the lungs, which were mostly situated near the surface. It is a not uncommon human parasite in the East, and was first found by Ringer in the bronchi of a man who came from Formosa. It is met with in China and Korea, and is especially common in Japan, where it gives rise to much pulmonary mischief. It is also recorded from North America, probably imported. Besides the tiger and man, it has been recorded from the pig, the dog, and the cat.

ACANTHOCEPHALA.

Echinorhynchus spirula Olfers.

Diesing, Syst. Helm. ii. p. 21.

A considerable collection of specimens of this species of *Echinorhynchus* was sent me from the following animals:—(i.) *Perodicticus potto* Bosman, or Bosman's Potto, found in the West Coast of Africa, the Gold Coast, Sierra Leone, and the Gaboon; (ii.) *Lemur coronatus* Gray, the Crowned Lemur, from Madagascar; and (iii.) *Lemur brunneus* v. d. Hoeven, the Black-headed Lemur. The latter is the name given in the 'Catalogue of the Animals in the Zoological Gardens,' but I have been unable to find it or any synonym for it in Trouessart's great catalogue *.

This species of parasite is recorded in von Linstow's 'Compendium der Helminthologie' as occurring in *Inuus ecaudatus* Geoffr. (= *Pithecus innuus* L., *vide* Trouessart's 'Catalogus Mammalium,' Berlin, 1898–1899, p. 26), from Gibraltar and Northern Africa, and from *Cebus fatuellus* Erxleben, from S. America. Raillet † points out that Leuckart considered this species may be the same as the *E. hominis* Lambl., which was found, in one instance only, in the small intestine of a child of nine years of age who died at Prague in 1857.

PENTASTOMIDA.

Porocephalus crotali (Humboldt).

Echinorhynchus crotali Humboldt.
Distoma crotali Humboldt.
Polystoma proboscideum Rudolphi.
Linguatula proboscidea van Beneden.
Pentastomum moniliforme Diesing, Megnin (in parte).
Linguatula quadriuncinata Meyer.
Pentastomum imperatoris Macalister.
Pentastomum proboscideum Rudolphi.

* [The Lemurs which have been almost continuously exhibited at the Gardens for many years under the name of *Lemur brunneus* v. d. Hoeven are almost certainly identical with *L. mongoz* var. *nigrifrons* M.-Edw. et Grandidier. See Sclater, P. Z. S. 1871, p. 231.—P. C. M.]

† 'Zoologie Médicale et Agricole.' Paris, 1895.

Larval forms:—

Pentastomum subcylindricum Diesing.

Pentastomum clavatum Wyman.

Three specimens, the largest measuring 11 cm., were taken from the lungs of a *Zamenis mucosus* Boul., a snake which occurs from Transcaspia and Afghanistan, across Asia, to the sea-board of China and to the Malay Peninsula and Java. In my "Attempt to revise the Family Linguatulidæ" (Archiv. Parasit. i. 1898, p. 52) I have given a list of the numerous hosts which harbour this form.

There were also some encysted larval forms coiled up in pieces of the liver or in fragments of membranous tissue which looked like mesentery. In the relationship of the mouth to the hooks and in the general appearance of the head they resemble *P. crotali*, but they have an unusual number of annuli, quite fifty. These annuli in the Pentastomida are obviously very variable characters, and they do not correspond with any true segmentation. It has sometimes occurred to me that their number depends upon the closeness of the coil in which the larva lies. These larvæ, at any rate, were very closely coiled.

POROCEPHALUS MONILIFORMIS (Diesing).

Pentastoma moniliformis Diesing.

A single specimen, somewhat injured, from *Python* sp.

The club-shaped head and the moniliform character of the segments and the pointed tail were very marked. The number of segments, counting the terminal joint, was 28, thus agreeing with Diesing's figure *.

POROCEPHALUS HERPETODRYADOS, n. sp.

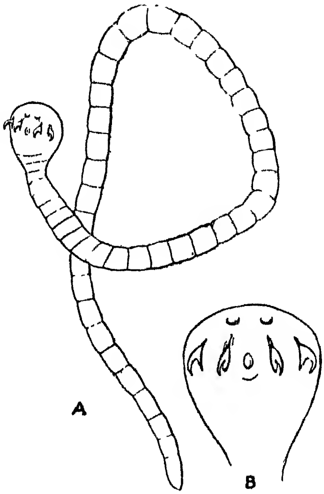
Diagnosis.—Length averaging about 10 cm., breadth 2·5 to 3 mm. in the body, in the head 4·5 to 5 mm. About 50 annuli. There are no depressions between these, or hardly any; the body is smooth, and although the segments are quite distinct they pass smoothly into one another like the nodes of an Equisetum. The head is separated from the body by a distinct neck which is faintly annulated, as is the posterior part of the head. The four hooks are in one straight line, and the posterior border of the oval slit-like mouth is on a line with the posterior border of the hooks. The hooks are simple, there is no accessory hooklet. There are four conspicuous papillæ just in front of the hooks.

The presence of a distinct neck associates this species with *P. annulatus* Baird and *P. tortus* Shipley, but the neck is not so distinct from head and body as in the former, or so short as in the latter of these two species. The hooks, which have no accessory hooklet, have a well-developed flange as in *P. subuliferus* Lckt. and many others. The hooks are strongly curved, and under the

* Denk. Ak. Wien, xii. 1856, p. 31.

microscope not very sharp. The head is rounded dorsally and flattened ventrally; it slopes down gradually to the neck.

Text-fig. 52.



Porocephalus herpetodryados.—A. Entire worm. B. Head, much magnified.

This form came from a specimen of *Herpetodryas carinatus*, probably from the lungs. The particular specimen was killed in Honduras, but this species of snake extends in South America east of the Andes to the Rio de la Plata, and is found in Trinidad, Guadeloupe and St. Vincent.

NEMATODA.

Angiostomum serpenticola von Linstow.

v. Linstow, Centrbl. Bakter. xxxvii. 1904, p. 678.

Von Linstow describes the females which in this genus become hermaphrodite whilst living in the lungs and pleural cavities of Amphibia, Reptiles, and more rarely Birds. The larvæ develop in or on the earth, and form a *Rhabditis*-like bisexual generation in those species whose life-history is known. These specimens were viviparous, the uterus being crowded with young embryos.

Numerous specimens from the lungs of the "Hog-nosed" Snake, *Heterodon platyrhinus*.

Ascaris angusticollis Molin.

Molin, SB. Ak. Wien, xl. p. 336.

v. Drasche, Verh. Ges. Wien, 1883, p. 209.

Mobius's specimens came from the coats of the intestines of *Buteo vulgaris*, the Buzzard. Von Drasche gives two views of the

head. My specimens come from the intestines of the *Helotarsus ecaudatus*, the "Berghaan" or "Bateleur" Eagle.

Ascaris capsularia Rud.

Filaria piscium Leuck.

Diesing, Syst. Helminthum, ii. p. 163.
Leuckart, Menschl. Parasit. ii. p. 98.
Zschokke, Arch. Biol. 1884, p. 1.
Von Linstow, Arch. Naturg. 1878, p. 236, 1880, p. 45, & 1884, p. 127.

Numerous specimens of the larvæ of this form were given me by Dr. Harmer. The young Nematodes were partly free and partly encapsuled, and in both cases they were much coiled. They were found in the tissues of a Scabbard-fish (*Lepidopus caudatus*), and are labelled "Portugal, Dec. 1903."

This species has been described from *Lepidopus argyreus* Cuv., *Gadus morrhua*, *Aphanopus carbo*, *Scomber scomber*, *Lophius piscatorius*, *Trigla gurnardus*, *Cyclopterus lumpus*, and many other fishes.

Ascaris lumbricoides L.

Two smallish specimens, one male and one female, were taken from the nostril of a Chimpanzee (*Troglodytes anthropopithecus*) in the Zoological Gardens.

Filaria foveata Schneider.

Schneider, Monographie der Nematoden, 1866.

My specimens were sent me by Mr. Rosenberg, the naturalist, of Haverstock Hill, London; they were found in the orbit—"entre craneo y cuero"—of an *Asio brachyotus*, shot at Tucumán in the Argentine Republic. Schneider records specimens from the same bird, which he calls by the old name of *Ægolius brachyotus*, but he does not mention in what part of the bird they were found. In the British Museum Catalogue the bird is registered under the name *Asio accipitrinus*.

Filaria physalura (Bremser).

Menapetalonema physalurum Bremser.

Molin, SB. Ak. Wien, xxviii. 1858, p. 412.
Diesing, SB. Ak. Wien, xlii. 1861, p. 710.

This species has been recorded from *Alcedo amazona* Latham, from the body-cavity of both the thoracic and abdominal regions. My specimens are from the abdominal region—"en el vientre"—of a male *Ceryle torquata* shot at Tucumán in Argentina. The specimens were sent me by Mr. Rosenberg, the naturalist, of Haverstock Hill, N.W.

Filaria quiscali von Linstow.

Von Linstow, Arch. Naturg. Jahrg. 1904, Bd. i. p. 300.

Dr. von Linstow, to whom I sent the Nematodes mentioned in

the 'Proceedings' * of last year, which were taken from the brain of the *Quiscalus versicolor* Vieillot, has described the parasite as a new species. Unfortunately the specimens were but fragments, bearing no head. The tail end is rounded. The breadth 0·21 mm. The body is uncommonly soft. The cuticle is smooth, not ringed. The eggs are 0·029 mm. long and 0·021 mm. broad.

These Nematodes were found in the hinder part of both cerebral hemispheres. They formed a tangled mass lying below the pia mater. "The bird was reported to have dropped down suddenly from its perch 'in a fit.'"

The position of these Nematodes in the brain is a very unusual one. Dr. von Linstow mentions that the only case known to him is that of *Filaria helicina*, found in the brain of *Plotus anhinga* from Florida.

SPIROPTERA sp.?

A number of larvæ identified by Dr. von Linstow as belonging to some species of *Spiroptera* were taken from *Centetes ecaudatus*. It is unfortunate that it was impossible to determine the species of this parasite, since, so far as I am aware, very little is known about the parasites of *Centetes*. All but one or two of the specimens in question were encapsuled in membranous tissue, probably peritoneal.

List of Hosts with their Parasites described in the foregoing Paper.

TREMATODA.

Host.	Parasite.	Position in host.
Felis tigris	*Paragonimus westermani* (Kerb.).	Lungs.

ACANTHOCEPHALA.

Lemur brunneus v. d. Hoeven	*Echinorhynchus spirula* Olfers.	
Lemur coronatus Gray	*Echinorhynchus spirula* Olfers.	
Perodicticus potto Bosman ...	*Echinorhynchus spirula* Olfers.	

PENTASTOMIDA.

Herpetodryas carinatus	*Porocephalus herpetodryados*, n. sp.	
Python sp.	*Porocephalus moniliformis* (Diesing).	
Zamenis mucosus Boul.	*Porocephalus crotali* (Humboldt).	Lungs.

NEMATODA.

Asio brachyotus	*Filaria foveata* Schneider.	Orbit.
Centetes ecaudatus	*Spiroptera* sp.	Encapsuled.
Ceryle torquata	*Filaria physalura* Brem.	Stomach.
Helotarsus ecaudatus	*Ascaris angusticollis* Molin.	Intestine.
Heterodon platyrhinus.........	*Angiostomum serpenticola* v. Lins.	Lungs.
Lepidopus caudatus	*Ascaris capsularia* Rud.	Encapsuled.
Quiscalus versicolor	*Filaria quiscali* v. Lins.	Brain.
Troglodytes anthropopithecus.	*Ascaris lumbricoides* L.	Nostrils.

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* Proc. Zool. Soc. London, 1904, vol. ii. pt. i.: Abstract of the Proceedings of the Zoological Society of London, 1904, No. 7, p. 1.

4. The Rudd Exploration of South Africa.—III. List of the Mammals obtained by Mr. Grant in Zululand. By Oldfield Thomas, F.R.S., and Harold Schwann, F.Z.S.

[Received March 21, 1905.]

(Plate XVI.*)

[The complete account of the new species described in this communication appears here; but as the names and preliminary diagnoses were published in the 'Abstract,' such species are distinguished by the name being underlined.—Editor.]

In continuation of the collecting-work carried on by Mr. C. D. Rudd's generosity, by which our National Museum has already been so large a gainer, Mr. C. H. B. Grant spent November and December 1903, and again, after a visit to the Transvaal, June to September 1904, in Zululand, where he collected the specimens of which the present paper gives an account.

It was at Mr. Rudd's own suggestion that Mr. Grant went to Zululand, and the resulting collections have more than fulfilled any expectations that could have been formed as to the value and interest of a series obtained there, for quite a number of the species have proved to be altogether new to science, while in other cases forms only hitherto known from isolated or unlocalised specimens are now illustrated by good series of trustworthy skins.

In several instances we have been able to revise confused or little-known groups, such as *Myosorex* and the Golden Moles, with the result that a number of new forms have proved to need description.

Of these by far the most noteworthy is the handsome Hare which we have named *Pronolagus ruddi*, while other interesting species are the Golden Moles, *Amblysomus iris* and *A. chrysillus*, and the different forms of *Myosorex*.

The localities at which the specimens were obtained are as follows:—

Eshowe. Altitude 550 m.

Sibudeni and the Jususie Valley, about 20 miles to the N.W. of Eshowe. Altitudes 1100 to 1700 and 350 m. respectively.

Ngoye Hills, 15 miles E. of Eshowe, and about 8 miles inland from the coast. Altitude 200–300 m.

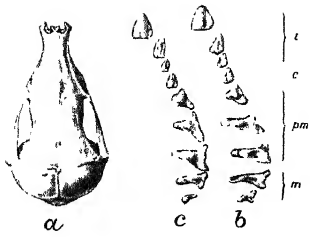
Umvolosi Station, 3 miles from the river of the same name and about 15 miles from the sea. Altitude 30–60 m.

Hluphuwe Stream; about 20 miles N. of Umvolosi.

Of the last localities Mr. Grant says:—

"Round the Umvolosi Station sandy grass-covered flats and undulating country stretch away to the south and east, dotted

* For explanation of the Plate, see p. 276.



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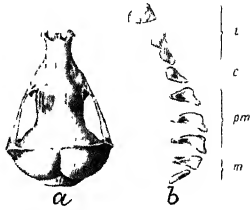

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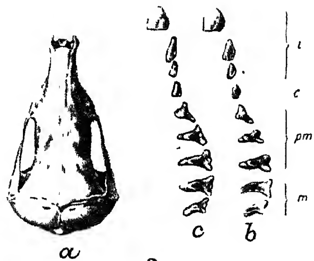

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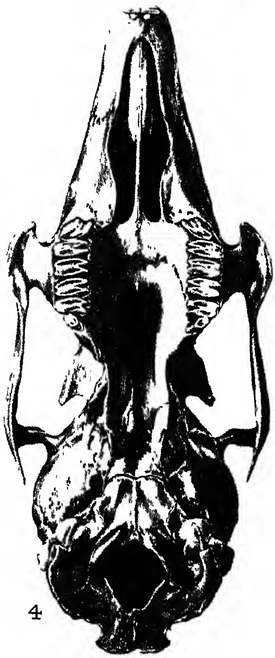

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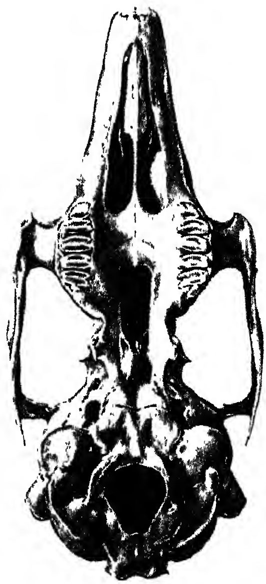


5

A. J. Engel Terzi, del.

Bale & Danielsson L.td

1-3. AMBLYSOMUS. 4-5 PRONOLAGUS.

with palms and thorn-bush, the thorns in places forming patches and thickets interspersed with a few good-sized trees, the surface broken with both dry and swampy pans and vleys, and deep swampy sluits filled with dense reeds intersect the country towards the river. A low range of hills runs along the coast. To the north the country becomes more broken and hills and deeper ravines begin to appear.

"About 8 miles to the south of the station is a dense thorn-forest of considerable size, called by the natives the 'Dukuduku,' which joins and disappears in the great swamps and reed-beds through which the Umvolosi River runs.

"Towards the Hlupeuwe and opposite the north end of the Lake the country is broken and hilly, palms are not so noticeable, but the thorns become common and more regular in appearance; often as one looks across some hillside or down a long valley they look park-like in their regularity. One would almost believe they had been planted by hand. Belts of thick bush fringe nearly all the rivers, often being very dense and wide."

After putting aside the duplicates, the Zulu collection, which, as in the previous cases, is presented to the Museum by Mr. Rudd, numbers 222 specimens belonging to no less than 49 species. It thus forms not only one of the most important accessions that the National Collection has ever received from this part of Africa, but, owing to the number of the new forms contained in it, affords a remarkable example of the need for such a scientific survey of the fauna as Mr. Rudd is carrying on in South Africa. Mr. Grant, the actual collector, is also to be congratulated on the striking results that have been obtained from his materials.

1. Papio porcarius Bodd.

♂. 588. Sibudeni.

"Zulu name 'Jufyane'*.

"Difficult to secure and more often heard than seen, as they live in large troops in the thick forest.

"They feed principally on fruit, and where wild fruit abounds they can sometimes be obtained by waiting under the trees, but they are at all times wonderfully wary."—C. H. B. G.

2. Cercopithecus pygerythrus Cuv.

♂. 832, 840. ♀. 827, 841. Umvolosi Station.

♂. 846. Hlatwa District.

The material at our disposal is at present insufficient to decide definitely as to the relationship of *pygerythrus* and *lalandii*, so we provisionally adopt the earlier name.

"Zulu name 'Nkau.'

"Common in the 'Dukuduku' thorn-forest, eight miles to the south of the station. Generally seen in parties of from six to

* "In the reading of the Zulu names, C, X, and Q are clicks; I is pronounced as E, A as R, H as S, and E as long A."—C. H. B. G.

twelve. In the early morning they sit on the tops of the trees and ant-heaps enjoying the sun. The natives living in the bush eat the 'Nkau,' while those of the open country will not touch it."—C. H. B. G.

3. GALAGO CRASSICAUDATUS Geoff.

♂. 677. ♀. 676. Eshowe.
♂. 881, 905. Ngoye Forest.
♂. 915. Ngoye Hills.

"Zulu name 'Suikwe.'

"Almost exclusively an arboreal animal.

"It sleeps during the day in some hollow tree, waking up at sundown, at which time and throughout the whole night its peculiar cry can be heard.

"At Eshowe it frequents the trees close to the houses and is said to be extremely fond of fowls' eggs.

"The specimens secured were shot at night with the aid of a dark lantern, flashing it suddenly into the tree where one was heard calling.

"This is a favourite method with the natives for obtaining them, by whom the skin is highly valued. Specimens from Natal seem much browner than those from Zululand."—C. H. B. G.

4. EPOMOPHORUS WAHLBERGI Sund.

♂. 879. Ngoye Forest.

"Zulu name 'Gomboqu.'

"This Bat does not fly till nearly two hours after dark. They fly low and are very strong and rapid on the wing. At this time of year they feed on the berries of the syringa-tree."—C. H. B. G.

5. RHINOLOPHUS AUGUR ZULUENSIS K. And.

♂. 920. Ngoye Hills.
♂. 601, 604, 605, 606, 607. ♀. 600, 602, 608. Jususie Valley.

This subspecies was described * mainly on Mr. Rudd's specimens, No. 602 being the type.

"Zulu name 'Am alulwane.'

"This and the two following Bats were all secured in the old prospecting drives that abound in the country. The natives do not distinguish between them, but call all Bats by one name.

"The Horseshoe Bat is generally the first to appear in the evening. It is often to be seen before the sun has disappeared.

"*Hipposiderus* is not so common as the others, many drives being visited without observing it."—C. H. B. G.

6. HIPPOSIDERUS CAFFER Sund.

♂. 626, 636, 637, 640. ♀. 638, 639. Jususie Valley.

* Ann. Mag. N. H. (7) xiv. p. 383 (1904).

7. Nycteris capensis Smith.

♂. 622, 625, 629, 630. ♀. 624, 631, 632, 635. Jususie Valley.

A comparison of these specimens with those obtained by Mr. Grant in Namaqualand shows that the latter have conspicuously larger ears.

It seems probable therefore that *N. damarensis* Peters †, of which a co-type in the British Museum has similarly large ears, should be recognised as distinct from *N. capensis*.

8. Pipistrellus kuhlii fuscatus Thos.

♀. 911. Ngoye Hills.

9. Scotophilus nigrita Schreb.

♀. 922. Ngoye Hills.

10. Vespertilio capensis gracilior, subsp. n.

♂. 678. Eshowe.

"Caught in the house at night."—C. H. B. G.

Smaller throughout than *V. capensis* (which includes "*V. minutus*" auct.). The fur shorter (hairs of back about 5 mm.). General colour, both above and below, darker, the light tips to the hairs shorter and browner. Back of ears less heavily haired at base. Skull smaller than that of *V. capensis*, but similar in shape. Teeth lighter and more delicate, with broader gaps between the inner halves of the upper molars, the inner lobe of the large premolars being particularly narrow.

Dimensions of the type (the starred measurements taken in the flesh):—

Forearm 29 mm.

Head and body *47 mm.; tail *28; ear *12; tragus 3·5; expanse *216. Length of third finger 52.

Skull—greatest length 13·2; basal length in middle line 10·1; mastoid breadth 7·8; height of brain-case 4·5; combined length of large upper premolar and first two molars on outer edge 3·1; front of lower canine to back of m_3 5·1.

Hab. Eshowe, 550 m.

Type. Male. B.M. no. 4.8.31.3.

In working out this smaller form of the common *V. capensis* we have had occasion to examine the specimens and names placed by Dobson under the headings of *V. capensis* and *V. minutus*, and have found a considerable amount of revision necessary.

In the first place, all the South-African specimens divided by Dobson between these two species belong apparently to but a single one, for which the name *V. capensis* Smith, the earliest of all, is available. The forearm varies from 32 to 36 mm. (generally about 34); its skull is about 14 mm. in greatest length; the

† MB. Ak. Berl. 1870, p. 905.

combined length of the large upper premolar and two molars is 3·4 mm.

Secondly, the name *V. minutus* Temminck (1835–41) is antedated by Montagu* (1808) for a Lesser Horseshoe Bat, and is therefore untenable for any member of the present group.

Next, *Vesperugo subtilis* Sundevall, placed by Dobson (with a query) in the synonymy of "*V. minutus*," is really a *Pipistrellus*, as we have found by the examination of the skull of the type, most kindly lent to us by Dr. Einar Lönnberg. It is, however, not *P. nanus*, as might have been expected, but a species with incisors and premolars as in *P. kuhlii*, to which, although much smaller, it would seem to be allied. Although degenerated by chemicals, the large upper premolar and first two molars may be measured as 2·4 mm., and the lower tooth-row (exclusive of incisors) as 4·0 mm. The species does not appear to have been rediscovered since Wahlberg's time.

Next, *Vesperugo smithii* Wagner, based on *Vespertilio minutus* Smith, of the 'Illustrations' (1848), placed by Dobson under *V. capensis*, must be a different Bat altogether, as it is said to have a forearm no less than 42 mm. in length.

Lastly, the Madagascar specimens referred by Dobson (and Peters, whose writing is on some of them) to "*Vesperugo minutus*" represent, as might have been expected, a species conspicuously different from its Cape ally. It may be called

VESPERTILIO MATROKA †, sp. n.

Size about as in *V. capensis*, though the skull is shorter. General colour above uniform rich brown, the type matching "vandyke-brown" of Ridgway, widely different from the greyish brown of *V. capensis*. Underside between "raw umber" and "mummy-brown," rather lighter on the lower abdomen. Ears rather smaller than in *V. capensis* and antitragal notch deeper. Other external characters apparently as in that species.

Skull shorter, more rounded, and with a less flattened brain-case than in *V. capensis*. Molars rounded, not so broad transversely. Canines smaller and slenderer, the difference especially marked in the lower jaw. Anterior lower premolar only about half the transverse diameter of the posterior one.

Dimensions of the type:—

Forearm 33·5 mm.; third finger 57.

[Head and body (of a spirit-specimen with forearm 32 mm.) 43·5; head 15·5; tail 29·5; ear 11·3; tragus on inner edge 4; lower leg and foot (c. u.) 19.]

Skull—greatest length 13·5; basal length in middle line 10; mastoid breadth 7·7; combined length of large upper premolar and two molars 3·2; front of lower canine to back of m_3 5.

Hab. Madagascar. Type from Ambositra, Betsileo. Altitude about 1100 m.

* Trans. Linn. Soc. ix. p. 163.

† Malagasy for "dark brown."

Type. Male. B.M. no. 97.9.1.32. Original number 177. Collected 2 February, 1895, by Dr. C. I. Forsyth Major.

This species is at once distinguishable from its mainland ally by its rich brown colour and differently shaped skull.

11. MINIOPTERUS SCHREIBERSI Natt.

♂. 921. Ngoye Hills.

12. AMBLYSOMUS IRIS Thos. & Schw.

Amblysomus iris Thos. & Schw. Abstr. P. Z. S. No. 18, p. 23, April 25, 1905.

♂ 873. ♀ 829. Umvolosi Station, 50 m.

(?) ♀ 874. Umvolosi Station.

In view of the considerable cranial and dental differences occurring between the different groups of the Chrysochloridæ, we think it advisable to accept the subdivision of the old genus *Chrysochloris* into three, as proposed by Prof. Cope*. All the specimens as yet obtained by Mr. Grant belong to the genus *Amblysomus* (type *A. hottentottus* Smith), no members of the genera *Chrysochloris* (type *C. asiatica* Linn.) or *Bematiscus* (type *B. villosus* Smith) having fallen into his hands.

With regard to the milk-dentition in this group, Dr. Leche has recently shown that the tooth-change takes places at an unusually late period of life, so that there is no cranial evidence of immaturity in specimens still retaining their milk-teeth. It is on account of this observation that we provisionally assign specimen no. 874 to the same species as 873 and 829, for while it shows no indication of youth the considerable difference between its teeth and those of the others might be explained by a difference of dentition †. But if this is the case, we practically have to assume that the whole of the Museum series of *A. hottentottus* are also in the milk-stage, for all have their teeth shaped as in 874 rather than as in 873 and 829. In support of this view, it should be noted that these two latter specimens are the only members of the genus which have their molars conspicuously more worn than the teeth anterior to them, thus showing that they at least have their permanent dentition.

Taking into consideration only the two specimens which are undoubtedly adult, the species may be described as follows:—

Size markedly smaller than in *A. hottentottus*, and the claws rather feebler. Nasal pad apparently as in that species. General colour smoky blackish, the hairs slaty at their bases, dark silvery

* Amer. Nat. xxvi. p. 127 (1892). The new name founded by Cope, *Bematiscus*, has the unusual distinction of being omitted from Palmer's 'Index Generum Mammalium.' Nor is it included in Trouessart's Catalogue, and we owe a knowledge of its existence to our friend Dr. Forsyth Major.

† We have later found conclusive evidence that the broadly triangular premolars of No. 874, as figured in the Plate, are the milk-teeth. The British Museum has also since received from Mr. C. W. Turner a specimen of *A. hottentottus* with its permanent dentition in place.—10 May, 1905.

grey subterminally, the tips black with a greenish iridescence. Sides rather lighter, but without rufous tinge, which is however present in specimen No. 874. Under surface dark grey ("mouse-grey"), a narrow median line rather darker. Chin dull whitish, which colour extends upwards on each side on to the cheeks. Crown and top of muzzle brown, finely flecked with white, and with a patch about 2 mm. in diameter over each eye. Limbs grey like the lower surface, the wrists lighter.

Skull similar in shape to that of *A. hottentottus*, but markedly smaller throughout.

Teeth: second and third incisors and canine similar in shape, the last-named not markedly more triangular in section. First premolar (Pl. XVI. fig. 1) triangular, not elongated transversely. Two posterior premolars, and the molars, quite separated from each other, broad transversely, very narrow antero-posteriorly, the outer cusps little developed, so that the outer antero-posterior diameter of p^4 is only about 1·1 mm. In No. 874, which we suppose to show the milk-dentition of the same species, this last diameter (including the prominent antero-external cusp) is about 1·5 mm. (see Pl. XVI. fig. 1). Below, the last two premolars and the two molars have each a low posterior basal ledge, off which a small cusp may have been worn. No. 874 has the usual distinct posterior basal cusps.

Dimensions of the type (measured in the flesh):—

Head and body 116 mm.; hind foot (s.u.) 13.

Skull—greatest length 25·4; basal length 20; greatest breadth 15·6; greatest height 12·3; interorbital breadth 8; front of i^1 to back of m^2 10; palate, breadth across premolars 8·7.

Hab. Umvolosi Station, altitude 50 m.

Type. Adult male. B.M. no. 4.12.3.9. Original number 873. Collected 16 September, 1904.

This distinct species may be readily recognised by its smaller size, as compared with *A. hottentottus*. From *A. obtusirostris* it differs in having its upper anterior premolars of a distinctly premolariform shape, Peters's species apparently having them of the molariform outline also found in *A. chrysillus*, described below.

These three specimens are of particular interest as illustrating the very late change of dentition in the group, recently discovered by Prof. Leche* in *Chrysochloris asiatica*.

While examining Mr. Rudd's specimens we have compared all the Museum examples of *Amblysomus hottentottus*, and find that the form found in Pondoland differs so much in colour as to deserve subspecific recognition. It might be called

AMBLYSOMUS HOTTENTOTTUS PONDOLIÆ, subsp. n.

Similar to true *A. hottentottus* in size and other essential characters, but the dorsal area, from crown to rump, is glossy

* Zool. Anzeiger, xxvii. p. 219 (1904). We owe to the kindness of Prof. Leche a drawing of a milk-premolar of the specimen he described.

blackish, as in *A. iris*, while the sides and under surface are still rufous, as in true *hottentottus*. But even the belly, in the most strongly marked examples, is of a rather smokier rufous than in the typical subspecies.

Dimensions of the type:—

Head and body 120 mm.; hind foot 14.

Skull—greatest length 27; greatest breadth 17; height 12·5.

Hab. of type. Notinsila, W. Pondoland. Other specimens from Port St. John.

Type. Male. B.M. no. 4.6.6.4. Collected 10 February, 1904, by Mr. H. H. Swinny. Four specimens examined.

The true *A. hottentottus*, of which the type is in the Museum, is a reddish animal, not or very slightly darkened on the back. The specimen from Zuurbron, near Wakkerstroom, obtained by Mr. Grant, and mentioned in our previous paper, agrees closely with the type, and other reddish specimens from King Williamstown and Albany are in the collection.

The species described as *Chrysochloris holosericeus* by Lichtenstein and *C. rutilans* by Wagner seem to be clearly referable to the true *A. hottentottus*.

C. albirostris Wagn. is also a reddish form, but may prove to be distinct. Its identification with *C. leucorhina* Huet by Pousargues* is based on a mistake, for Wagner stated clearly in 1855†, though he did not in 1841‡, that it had only 36 teeth, a statement which was overlooked by Pousargues.

Another member of the genus which we may take this opportunity of describing is

AMBLYSOMUS CHRYSILLUS, sp. n.

Nose-pad broad, more than twice as broad as long, its lateral corners angular, but not produced backwards into a long sharp point as in *Chrysochloris*; transverse groove or infolding little prominent, not running to the lateral edges. Nostrils extremely complicated, even more so than in *C. asiatica*, the opening nearly blocked up by in-growing foliaceous projections.

Size comparatively small. Large claw of fore foot small, slender, less curved than in *A. hottentottus*; its length 8·5 mm., its basal diameter 3·2; the small outer claw about $\frac{1}{4}$ the length of the large one, therefore longer in proportion than in the allied species. General colour pale, much paler than in any other species; the hairs of the upper surface with only their extreme tips brown ("wood-brown" in a specimen skinned out of spirit), the greater part of their length being silvery whitish (with a tinge of yellow in the type, but this is probably due to the spirit), very slightly greyer at their bases. The brown is as usual most intense on the

* Ann. Sci. Nat. (7) iii. p. 268 (footnote), 1896.

† Schr. Säug. Supp. v. p. 581.

‡ *Op. cit.* ii. p. 124.

crown, where it contrasts with the cheeks, which are yellowish white. Under surface yellowish white, the hairs light to their bases, line of demarcation on sides not defined. A slight greenish iridescence on the dorsal hairs.

Skull small, in general outline more broadly triangular than in *A. hottentottus*; the breadth across the molars nearly equalling the distance from the last molar to the tip of the first incisor.

Second and third upper incisors flattened and grooved externally. Canines more or less premolariform in shape, triangular in section. First premolar as elongated transversely as the first molar, its anterior lobe rounded and little projecting. Other premolars and molars with scarcely a trace of the usual antero-external projections. Lower teeth all unusually high; premolars and anterior molars each with a small but distinct low secondary cusp at the postero-internal angle—absolutely internal, not mesial as in other species.

Dimensions of a specimen in spirit:—Head and body 93 mm.; hind foot (s.u.) 10; nose-pad 5·4 × 11. The type is rather younger and smaller: head and body 82 mm.

Skull (the larger specimen)—greatest length 22; basal length in middle line 18; greatest breadth 15·6; greatest height 10·5; interorbital breadth 6·6; length of upper tooth-row 9·2; greatest breadth across premolars 8.

Hab. Delagoa Bay.

Type. Female. B.M. no. 84.8.30.2. Presented by Mrs. Monteiro. Two specimens examined.

This interesting little species has been hitherto confused with *A. obtusirostris*, but differs by its smaller size and whitish fur. Both species differ from *A. hottentottus* and its allies by the whole of their upper premolars taking on a molariform shape, while the canine even is pressed into the same service by having the shape usually characteristic of an anterior premolar.

As a result of this modification there are (putting aside the small m^2) four large molariform teeth (p^{1-3}, m^1) as compared with three (p^{2-3}, m^1) in *A. hottentottus* and its allies. (See Pl. XVI. fig. 2 *b*.)

13. MYOSOREX SCLATERI Thos. & Schw.

♂. 887, 888, 906, and one in spirit. ♀. 886, 889, 190. Ngoye Hills.

MYOSOREX SCLATERI TALPINUS, subsp. n.

♂. 814, 819, 823, and one in spirit. ♀. 818. Umvolosi.

MYOSOREX SCLATERI AFFINIS, subsp. n.

♂. 584, 641, 642. ♀. 580, 594, 643, 645, 666. Sibudeni.

A more detailed examination of the series on which this species was founded convinces us of the necessity of distinguishing subspecifically the specimens from the three localities mentioned above.

The characters of the three forms are briefly as follows:—

Myosorex sclateri sclateri.

General colour dark bistre-brown. Skull in length 25 mm. or over, about 12 mm. in breadth. Hind foot 16 mm.

Myosorex sclateri talpinus, subsp. n.

Larger. General colour above shining black, below sepia. Hind foot 18 mm.

Myosorex sclateri affinis, subsp. n.

Smaller. Colour as in true *sclateri*. Skull in length about 24·5 mm., in breadth about 11·3. Hind foot 15 mm.

Below is appended a full description of the two new subspecies:—

MYOSOREX SCLATERI TALPINUS.

General colour of upper surface shining black, lighter on flanks, passing to sepia on the under surface. Individual hairs above about 10 mm. long, basal four-fifths slate-grey, tip black. Long hairs on rump projecting noticeably beyond the short hair. Fur of under surface very fine and close, about 5 mm. long, basal two-thirds slate-grey, distal third sepia. Upper sides of hands and feet light brown as in *sclateri*, claws light in colour and rather long. Tail dark brown above and below, no tuft at tip.

Skull as in true *sclateri*, considerably larger and more strongly built than in *M. varius*.

Dimensions of the type (measured in the flesh):—Head and body 100 mm.; tail 56; hind foot 18; ear 11.

Skull—back of condyle to front face of i^1 25; basal length 21; breadth across brain-case 12·5; length of upper tooth-series 10·5.

Hab. Umvolosi, Zululand, alt. 60 m.

Type. Male. B.M. no. 4.12.3.20. Original number 823. Collected 23 July, 1904. Four specimens examined.

This subspecies may be easily distinguished from any other form by its dark velvety coat, which is very like that of a Mole.

"Zulu name 'Ngoso ukulu.'

"Inhabits the thick undergrowth on the banks of streams."—C. H. B. G.

MYOSOREX SCLATERI AFFINIS.

Smaller. Colour as in true *sclateri*. Skull smaller throughout (see measurements below); the size rather more constant in the males than in females. The breadth across the brain-case is noticeably greater in *sclateri* than in the present form, whose skull therefore appears very slender when compared with that of the Ngoye Hills race. The antero-posterior measurement of the second upper molar is slightly larger in *sclateri* than in *affinis*.

Dimensions of the type (measured in the flesh):—Head and body 84 mm.; tail 46; hind foot 15; ear 9.

Skull—back of condyle to front face of i^1 24·5; basal length 19·8; breadth across brain-case 11·5; length of upper tooth-series 10.

Hab. Sibudeni, Zululand. Alt. 1700 m.

Type. Male. B.M. no. 4.1.5.25. Original number 641. Collected 17 December, 1903. Eight specimens examined.

14. MYOSOREX VARIUS Smuts.

♀. 665. Sibudeni.

♂. 806, 815 (1 in spirit). Umvolosi.

"Zulu name 'Cwinini.'

"They are common everywhere, inhabiting the thick grass and undergrowth along the spruits, in the vleys and at the edge of the bush, also in the bush itself, especially under fallen trees. They apparently live on the surface of the ground and do not burrow. They feed principally on small insects and are both nocturnal and diurnal."—C. H. B. G.

A specimen collected at Umvolosi, B.M. no. 4.12.3.22, appears to represent a species allied to *M. tenuis*, but we are unable to decide definitely as it lacks its skull.

15. CROCIDURA MARTENSI Dobs.

♂. 817. ♀. 831 (2 in spirit). Umvolosi.

♂. 909 (1 in spirit). Ngoye Hills.

"Zulu name 'Ngoso.'

"Habits probably similar to *C. flavescens*. Not by any means common."—C. H. B. G.

16. CROCIDURA FLAVESCENS Geoff.

♂. 892. ♀. 894. Ngoye Hills.

This series agrees very well with the specimens we consider typical of *flavescens* Geoff., which is not the case with the series from Umvolosi.

"Zulu name 'Ngoso.' Common. Inhabits the cultivated and deserted native lands, the thick undergrowth in the vleys and on the banks of streams. Entirely nocturnal."—C. H. B. G.

17. CROCIDURA FLAVESCENS FLAVIDULA, subsp. n.

♂. 860, 861, 870. ♀. 830, 866, 869. Umvolosi.

Size smaller than in true *flavescens*. Colour throughout as in that animal, the tone, perhaps, slightly warmer.

Upper surface rather lighter than "Mars brown" (Ridgway); under surface smoke-grey, frequently with a yellowish suffusion. Interramia and wrists indistinctly white in several specimens. Old males with a well-developed lateral gland, the hair covering it conspicuously whiter than the surrounding pelage.

Skull and teeth much smaller and more delicately built than in true *flavescens*, the difference in size being very marked in the molar teeth; m^2 in the type of *flavidula* is only 2·6 mm. in breadth, while it is 3·2 mm. in the case of the larger form.

Dimensions of the type (measured in the flesh):—Head and body 102 mm.; tail 51; hind foot 14·5; ear 10.

Skull—back of condyle to front face of i[1] 23·5; basal length 20·5; breadth across brain-case 10; length of upper tooth-series 9·8.

Hab. Umvolosi, Zululand. Alt. 70 m.

Type. Male. B.M. no. 4.12.3.29. Original number 861. Collected 5 September, 1904. Six specimens examined.

While there is a general agreement in size throughout the Shrews assigned to *C. flavescens*, these specimens from Umvolosi are so markedly smaller that we think they should have a subspecific name.

18. HERPESTES GRACILIS PUNCTULATUS Gray.

♂. 581. ♀. 610, 614, 653. Sibudeni.
♂. 833. ♀. 800. Umvolosi.
♀. 899. Ngoye Hills.

As we have shown in a previous paper, *H. g. punctulatus* is a perfectly tenable subspecies, which is widely distributed over South-east Africa, being replaced further north by the paler *H. g. cauui.*

"Zulu name 'Cagiti.'

"Seems to be exclusively a bush animal, living singly or in pairs, but not in colonies. It is more often taken with dogs than trapped. It sleeps and breeds in some hollow tree and lives principally on insects."—C. H. B. G.

19. HERPESTES GALERA Erxl.

♀. 917. Ngoye Hills.

20. CROSSARCHUS FASCIATUS Desm.

♂. 852, 853. ♀. 855, 856. Umvolosi.

"Zulu name 'Oguya.' On the whole rather a rare animal. It frequents the thorn-bush and thickly wooded sluits and river-banks, generally in parties of half a dozen. When chased the whole party will, as a rule, take shelter in the same hole. The skin, especially the banded part of the back, is valued by the natives. It feeds principally on coleopterous insects."—C. H. B. G.

21. LYCAON PICTUS ZULUENSIS Thos.

Two native skins. Itala Mts.

"Zulu name 'N'Kenjane.'

"The two specimens sent were obtained by the natives from a troop of some eight individuals which had probably come from the Umvolosi River. The survivors did not remain long, but returned to the river.

"The natives say they are rather savage when hard pressed, and are very destructive to goats and sheep."—C. H. B. G.

22. Pœcilogale albinucha Gray.

♂. 659. Sibudeni.
♀. 598. Jususie Valley.

"Zulu name 'Myenelesana.'

"Common, but exceedingly difficult to trap. They frequent the thick overgrown sluits and kloofs in and around the Kaffir mealie-patches, but do not live in the bush.

"The male specimen was killed in the act of eating a vley *Otomys*.

"They have a pungent smell, but not so strong as *Ictonyx capensis*."—C. H. B. G.

23. Sciurus palliatus ornatus Gray.

♂. 880, 895, 901, 907, 910, 914. ♀. 884, 891, 903, 908, 912, 913. Ngoye Hills.

"Zulu names 'Inpuguloti' or 'Ijindane.'

"Similar in habits to the European squirrel. It is not easy to approach and keeps entirely to the thick forest. It does not seem to live in parties, but two are often observed together. This animal is curiously local in Zululand. It is common at Ngoye, in the neighbourhood of Kosi Bay, and on the Maputa River. Near the mouth of the St. Lucia Lake and in the bush toward Cape Vidal it is rare. It is unknown between Ngoye and the Lake district and in Natal."—C. H. B. G.

24. Tatera brantsii Smith.

♂. 838, 842. ♀. 813, 839, 872. Umvolosi.

"Zulu name 'Ibuusi.'

"Fairly common, especially in the native gardens and potato-patches. Their burrows are of considerable size, especially on the grass-covered flats, where they are undisturbed. This animal is very wary of traps, and can only be caught with a buried trap baited with a sweet potato. I tried digging them out, but the holes went down to such a depth that they were lost in the loose sand. Strictly nocturnal and a vegetable feeder."—C. H. B. G.

25. Graphiurus murinus Desm.

♂. 595, 656. ♀. 648, 663, 672. Sibudeni.

"Zulu name 'Mpuguloti.'

"Fairly common, but nocturnal. Almost exclusively a bush animal, though sometimes found in the rocks on the hill-sides some little distance from the bush."—C. H. B. G.

26. Otomys irroratus Brants.

♀. 675. Sibudeni.

This specimen agrees closely in skin and skull-characters with the series collected by Mr. Grant in the neighbourhood of Cape Town, which may be considered as representing Brants's *irroratus*.

"Zulu name 'Ibusi.'

"Fairly common, frequenting the overgrown sluits and vleys

close to water. Like other members of the genus, they will seldom take baits, but are usually caught by their accidentally running over the trap. They live singly or in pairs, and do not burrow."—C. H. B. G.

27. OTOMYS LAMINATUS Thos. & Schw.

Otomys laminatus Thos. & Schw. Abstr. P. Z. S. No. 18 p. 23, April 25, 1905.

♂. 657. ♀. 673. Sibudeni.

This species may be shortly described as a member of the *irroratus* group, with nine or occasionally ten laminæ on the third upper molars instead of six or seven, and seven on the first lower instead of four.

General colour of the upper surface, in the type, raw umber (Ridgway), slightly more rufous on the rump, which may, however, be due to faded fur, and paler on the flanks. The female distinctly darker in colour, more as in *irroratus*. Fur soft, fine, and thick, about 20 mm. long, basal four-fifths blackish slate, a subterminal ring rufous, extreme tip black. Under surface dull yellowish, the bases of the hairs grey. Forehead and cheeks like back; lips, interramia, and throat dull yellowish white. Ears of medium length, internal surface thinly covered with fine yellowish hair, naked externally. Upper surface of hands and feet blackish grey. Tail thickly barred, blackish above, dull buffy below.

Skull as in *irroratus*, but with a widely different laminal formula, viz.: $\frac{3-2-9}{7-2-2}$.

Dimensions of the type (measured in the flesh):—Head and body 180 mm.; tail 120; hind foot 31; ear 22.

Skull—greatest length 44; basilar length 35; zygomatic breadth 22; nasals 20×8·4; interorbital breadth 4·5; palate length 20·4; length of upper molar series (crowns) 9·7; antero-posterior diameter of bulla 7·2.

Hab. Sibudeni, Zululand. Alt. 1050 m.

Type. Male. B.M. no. 4.5.1.45. Original no. 657. Collected 1 January, 1904.

The difference between the laminal formula of this species and *O. irroratus* is so great that we have no doubt the former should be specifically distinguished. Mr. Sclater, in his 'Mammals of South Africa'*, mentions a specimen from Pondoland that agrees with *laminatus* in having nine laminæ on the third upper molar, and should probably be referred to this species. With the exception of this specimen, no greater variation has been recorded than between six and seven.

With regard to Lichtenstein's *Euryotis obscura* from Kaffraria, we are informed by Dr. Matschie that the type is not now to be found in the Berlin Museum, so that the name may well remain buried in the synonymy of the common *O. irroratus*.

* Vol. ii. p. 27.

28. MUS CHRYSOPHILUS de Wint.

♂. 577, 593, 596, 661, 670. ♀. 592, 575, 591, 658. Sibudeni.
♂. 620. ♀. 617, 627. Jususie Valley.
♂. 808, 812, 820, 858. ♀. 797, 821, 835, 868. Umvolosi.
♂. 885, 919. ♂. 918. Ngoye Hills.

"Zulu name 'Gwenca.'

"Inhabits the clumps of rocks on the hill-sides and krantzes, as in other parts of the country; it occasionally invades houses, where it is a perfect nuisance. Mainly a vegetable feeder and nocturnal."—C. H. B. G.

29. MUS DOLICHURUS Smuts.

♂. 878. Ngoye Hills.

30. MUS COUCHA ZULUENSIS, subsp. n.

♂. 576, 579, 582, 644. ♀. 574. Sibudeni.
♂. 513. ♀. 571, 572. Eshowe.
♂. 621, 628. Jususie Valley.
♂. 789, 807. ♀. 786, 788. Umvolosi.

A long-tailed, fulvous-suffused form of the *coucha* group.

General colour of the upper surface "bistre," with a distinct fulvous suffusion, which is much more marked in some specimens than others. Posterior half of the back strongly pencilled with black. Fur very soft and fine, the hairs of the back about 10 mm. in length. Underfur slaty-grey basally, fulvous at tip. Flanks lighter than back, buffy yellow fading into the greyish white of the under surface. Fur of belly grey basally, dirty white terminally, except on interramia, where it is entirely white. Head coloured like back. Ears covered with minute very dark brown hairs. Hands and feet dirty white or cream-colour, very different from the snowy white feet of true *coucha*. Tail considerably longer than in *coucha*, brown above, lighter below; scales about 13 to the centimetre.

Skull slightly larger than in the typical subspecies and with longer palatine foramina.

Dimensions of the type (measured in the flesh):—Head and body 123 mm.; tail 123; hind foot 23; ear 19.

Skull—greatest length 30·5; basilar length 25·0; brain-case breadth 12·0; zygomatic breadth 34·5; length of palatine foramina 7·3; length of upper molar series 4·5.

Hab. Umvolosi Station, Zululand. Alt. 70 m.

Type. Female. B.M. no. 4.12.3.62. Original number 786. Collected 25 June, 1904.

An examination of the type specimen of Smith's *coucha*, and of other modern specimens from the same region, shows that that animal is a shorter-tailed, smaller, whiter-footed, and greyer form than its representative in Zululand, to which we have therefore decided to give a special name.

The only other South African form in this group is *M. silaceus* Wagn., of which Thomas has examined the type in the Munich

Museum. This has a tail only 85 mm. in length, as in *coucha*, and so may be provisionally retained in the synonymy of that species, where it has been placed by de Winton and Sclater.

31. Mus colonus Brants.

♂. 787, 792, 793. ♀. 798. Umvolosi.

The four specimens correspond closely with the type of *Mus natalensis* Smith.

"Zulu name at Umvolosi 'Igundane,' literally 'a rat.'

"Common everywhere, both in the country and the native kraals. Nocturnal only."—C. H. B. G.

32. Leggada minutoides Smith.

♀. 589. Sibudeni.

♀. 871 (1 in spirit). Umvolosi.

"Zulu name 'Ngoso.'

"Apparently rare; the specimens obtained were trapped in thick bushes close to houses. Nocturnal only."—C. H. B. G.

33. Arvicanthis dorsalis Smith.

♂. 882. ♀. 883. Ngoye Hills.

"Zulu name 'Mbiba.'

"It is undoubtedly rare and very local."—C. H. B. G.

34. Arvicanthis pumilio Sparrm.

♂. 587, 590, 654, 655, 660. ♀. 585, 649. Sibudeni.

♀. 795. Umvolosi.

This very richly marked series shows an unusual amount of variation from light yellowish grey to strong buffy yellow.

"Zulu name 'Mbiba.'

"Common in all grassy places, exclusively diurnal and a vegetable feeder. It makes single holes in which to breed and sleep."—C. H. B. G.

35. Saccostomus mashonæ de Wint.

♂. 796, 851, 862, 867. Umvolosi.

We are glad to be able to continue the use of the familiar generic name *Saccostomus*, as we do not consider that it is invalidated by the existence of the earlier *Saccostoma* Fitzinger, on whose account Mr. Palmer has renamed it *Eosaccomys* *.

"Zulu name 'Igundane.'

"Uncommon. Inhabits the undergrowth on the banks of streams and the native lands. The pouches contained mostly sweet potato and seeds of various wild plants. Nocturnal only."—C. H. B. G.

36. Steatomys pratensis Peters.

♂. 791. Umvolosi.

Should the Zululand form be found to differ from that in-

* Science, (2) xvii. p. 873 (1903).

habiting the Zambesi Valley, the name *krebsii* Peters would probably be available for it.

"Zulu name 'Ngoso.'

"The specimen sent was the only one observed and was caught in the long grass on a sandy slope close to a stream. The natives did not know whether it was common or not."—C. H. B. G.

37. GEORYCHUS HOTTENTOTUS Less.

♀. 843. Umvolosi.

"Zulu name 'Mfuvuzi.'

"This animal makes runs and mounds similar to *Amblysomus*. It occasionally works just below the surface. It is very partial to the native lands and is strictly a vegetable feeder."—C. H. B. G.

38. DASYMYS INCOMTUS Sund.

♂. 651, 669. Sibudeni.

"Zulu name 'Ibusi.'

"Habits very similar to *Otomys irroratus*, frequenting the vleys like that species, but not necessarily close to water."—C. H. B. G.

39. THRYONOMYS SWINDERENIANUS Temm.

♂. 618. Jususie Valley.

♂. 875, 876 imm. Umvolosi.

♂. 850. Hlupluwe Stream, Hlatwa District.

"Zulu name 'Ivondwe' ('Mavondwe' plural).

"Not so common as it might be owing to its being killed off by the natives, both for food and because of the havoc it works among the mealies. It inhabits the thickly overgrown sluits and banks of streams, as a rule close to some mealie-garden. It is very quick when pursued and is only to be caught by using dogs. It cannot be trapped owing to the softness of its skin and flesh, the part that is trapped being pulled off and left."—C. H. B. G.

40. LEPUS SAXATILIS ZULUENSIS, subsp. n.

♂. 799. Umvolosi.

Similar to the true *saxatilis*, but smaller and with shorter ears.

General colour above drab-brown, freely pencilled with black; flanks much lighter, owing to the absence of the black annulation. Individual hairs about 20 mm. long, basal two-thirds grey (no. 9, Ridgway), subterminal ring dark brown, tip "ecru-drab"; underfur very thick, grey basally, dark smoky-brown terminally. Under surface pure snowy white; throat coloured like back. Muzzle, interramia, and a ring round eyes dirty white; cheeks, forehead, and anterior surface of ears coloured like back, internal margin of ears lined with light buffy hairs, external margin with white, tips of ears black. Nape of neck bright "ochraceous-buff." Under surface of fore and hind limbs pure white; upper surface light sandy grey. Tail black above, white below.

Skull considerably smaller than in the Cape form, and with smaller bullæ (see measurements below).

Dimensions of the type (measured in the flesh):—Head and body 467 mm.; tail 94; hind foot 109; ear 106.

Hab. Umvolosi Station, Zululand.

Type. Male. B.M. no. 4.12.3.91. Original number 799. Collected 30 June, 1904.

This Eastern form of the common *L. saxatilis* is so much smaller, and has such a conspicuously smaller skull, than its Cape ally, that we have no alternative but to give it a special subspecific name. Further material from different localities will be needed before any exact idea of its distribution can be obtained.

While comparing the specimen with the Museum series of skins, we have also been much struck by the characters of the three specimens of this group collected by Mr. Grant at Klipfontein, noticed by us in our paper on the Namaqualand collection.

This Western race is markedly larger than the Southern or Cape form, represented in the collection by two specimens from Deelfontein collected by Messrs. Grant and Seimund during the late war. In agreement with Waterhouse* and other authors, we synonymise the remainder of the names hitherto applied to members of this group with the true *Lepus saxatilis* Cuv., of which, in the absence of modern material from the neighbourhood of Cape Town, we provisionally take a Deelfontein example as representative. We propose to call the Namaqualand form

LEPUS SAXATILIS MEGALOTIS, subsp. n.

Size very large. General colour as in *zuluensis*; flanks and throat rather lighter; muzzle, cheeks, and round the eyes silvery grey; basal two-thirds of internal margin of ears lined with long pale buffy hairs, distal third lined with black, external margin bordered with white. Nape-patch between "clay-colour" and "isabella-colour" (Ridgway), rather darker than in *zuluensis*; hair on under surface of fore and hind limbs grey basally with white tips, producing a silvery appearance; tail much longer than in the Zulu or Deelfontein forms.

Skull approximately of the same size as that of the specimen from Deelfontein taken as typical of true *saxatilis*, in spite of the fact that its external measurements are much greater.

	Dimensions of the type from Klipfontein.	Specimen from Deelfontein, B.M. no. 3.3.6.11.
	mm.	mm.
Head and body.........	542	528
Tail	132	115
Hind foot	137	128
Ear	147	130

Hab. Klipfontein, Namaqualand.

Type. B.M. no. 4.2.3.103. Original number 520. Collected 23 June, 1903.

* Nat. Hist. Mamm. vol. ii. p. 93 (1848).

A short table of comparative skull-measurements will serve to show the distinctness of the Zululand form, while the Namaqualand race may be distinguished at once by the great size of the ears.

	Type of *L. s. megalotis.*	Specimen from Deelfontein, B.M. no. 3.3.6.11.	Type of *L. s. zuluensis.*
	mm.	mm.	mm.
Greatest length	102	103	91
Basilar length	77·5	79	70
Zygomatic breadth	44	45·5	42
Nasals, oblique length	43·5	44	40
,, greatest breadth	23	23·4	21
Interorbital breadth, inside wings	21	20	17·5
Breadth of brain-case	33	33	29·5
Diastema	30	30	25·5
Palate length	37·5	38	34
Palatal foramina	27×12	27·5×10	24·5×11
Length of cheek tooth-series	16	17	15·5
Antero-posterior diameter of bulla	12	13	11

It is perhaps worth mentioning that in the type of *L. s. megalotis* the small posterior molar m^3 is wanting on both sides of the upper jaw. This abnormality occurs, according to the observations of Dr. Forsyth Major, more frequently in Hares of this species than in any other.

"Zulu name, 'Gwaja.' Rather scarce, owing to the continuous persecution of the natives with traps and snares."—C. H. B. G.

41. Pronolagus ruddi Thos. & Schw.

Pronolagus ruddi Thos. & Schw. Abstr. P. Z. S. No. 18, p. 23, April 25, 1905.

♂. 664. Sibudeni.

This fine Hare, which we have named in honour of Mr. Rudd, has a somewhat complicated history, owing to a confusion between it and the true *P. crassicaudatus* Geoff.

In 1832 the latter species was described on a specimen from "Port Natal" still in the Paris Museum. This typical specimen is mounted, and has its skull still in the skin, whence none of the successive Directors have thought fit to have it extracted.

In 1853 the British Museum received from the Zoological Society's Museum a *Pronolagus* which was determined as *P. crassicaudatus*, and remained the only adult representative of the group until comparatively lately. It was therefore always treated as being the true *crassicaudatus*, as, for example, in Thomas's paper* describing *Oryctolagus c. nyikæ* and *curryi*, where its hind foot and cranial lengths are quoted as being those of Geoffroy's animal.

* Ann. Mag. N. H. (7) x. p 244 (1902).

But on the arrival of the fine series from Deelfontein, Namaqualand, and Zuurbron that have resulted from the Sloggett and Rudd collections, it soon appeared that this specimen belonged to quite a distinct species, different both in size and cranial characters, and of which we have had great pleasure in recognising a second specimen in the present example.

The specimen, "No. 22972," used to illustrate *P. crassicaudatus* in Mr. Lyon's recent work on Leporidæ* is evidently also an example of this larger and rarer species.

But as the two species both occur in or at least near Natal, the type locality of *crassicaudatus*, and are very similar externally, the question has naturally arisen as to which is the original species described by Geoffroy. Fortunately Mr. J. L. Bonhote has been able to settle the question for us by taking over to Paris, and comparing directly with the type, an example of the smaller species from Natal collected by Mr. Wroughton. Judging mainly by the length of the foot and the quality of the fur, Mr. Bonhote is definitely of opinion that the type of *crassicaudatus* is the smaller form, and we therefore now describe the larger one as new:—

Size larger than in *crassicaudatus*. Fur very distinctly harsher, as coarse as in a European Hare, while in *crassicaudatus* the fur is very soft, especially on the feet. Ground-colour coarsely grizzled black and pale buffy, the long hairs black with a pale buffy subterminal ring. Wool-hairs everywhere slaty-grey basally, but their tips blackish brown on the back, buffy rufous on the rump, and buffy on the sides. Head, and especially cheeks, clearer grey. Under surface reddish buffy, the centre of the belly more whitish. Front half of outer surface of ears pale greyish brown, its basal portion fringed with dull whitish hairs, its upper third narrowly edged with black, which disappears, however, on the extreme tip; inner surface of ear pale greyish white. Nape-patch dull greyish-brown, with but little tinge of rufous. Limbs buffy rufous, becoming more whitish on the digits. Tail not quite so bushy as in *crassicaudatus*, deep reddish throughout.

While the external distinctions from *crassicaudatus* are but little tangible, the skulls are extremely different, as may be seen by the following contrasted descriptions:—

In *P. ruddi* the skull is large (see measurements), heavily built, the muzzle broad and heavy proximally, and the frontal profile convex. Postorbital wings proportionally small, the posterior angle between them and the brain-case broad and open. Anterior shoulder of zygoma-root strongly projecting forward. Palatal foramina large, broad mesially, narrowing posteriorly, where they are constricted by the sharp inwardly-directed edges, which entirely hide in this region the walls of the nasal chamber below them. Sphenoid openings on each side of the front half of the presphenoid narrowed to mere slits. Bullæ very small, considerably surpassed by the paroccipital processes.

* Smiths. Misc. Coll. vol. xlv. (1904).

Incisors with their notch shallow, situated in a comparatively broad flattening of the front surface of the tooth. Large upper molars and premolars (shown in Lyon's pl. xci. fig. 8) with the uncrenulated anterior enamel-wall of the posterior lamina of each tooth extending nearly halfway across the tooth towards the outer border; crenulated adjoining outer parts of the enamel-walls of the two laminæ subequal in development, strongly crenulated. Anterior lower premolar with its anterior enamel-wall deeply crenulated. Thin front wall of the hinder lamina of each lower tooth (apart from m_3) very strongly crenulated.

In *P. crassicaudatus*, on the other hand, the skull is small, more slenderly built, the muzzle narrow, and the frontal profile flat. Supraorbital wings larger, their hinder edge closer to the brain-case. Anterior shoulder of zygoma small. Palatal foramina large, evenly broadened to their hinder edge, widely open behind, with slanting and scarcely ridged margins which do not hide the walls of the nasal chamber below. Sphenoid openings comparatively large. Bullæ fairly large, not surpassed by the small paroccipital processes.

Incisors with a comparatively deep sharply defined notch dividing the two strongly convex portions of the anterior surface. Large upper cheek-teeth with the uncrenulated part of the anterior enamel-wall of their posterior laminæ extending only about a third across the tooth; in the crenulated part of the enamel-walls the hinder wall of the anterior laminæ is considerably more developed than the front one of the posterior, and all are less strongly crenulated than in *P. ruddi*. Anterior lower premolar simply notched in front. Front wall of the hinder lamina of the large lower cheek-teeth scarcely crenulated.

It will thus be seen that while externally *P. ruddi* is very like *P. crassicaudatus*, the differences in the skull are so considerable that almost any part of the skull, or any single tooth, can be readily assigned to one or the other.

Dimensions of the type of *P. ruddi* (measured in the flesh):—Head and body 482 mm.; tail 52; hind foot 99; ear 98. (The hind foot of *P. crassicaudatus* is seldom over 80 mm.)

Skull—greatest length 92; basilar length 72; zygomatic breadth 40; nasals 44×22; interorbital breadth 16; intertemporal breadth 13·3; diastema 30; palatal foramina 26×8·5; palatal bridge 9·7.

Corresponding measurements of two members of the *P. crassicaudatus* group are to be found in Thomas's descriptions of *P. c. nyikæ* and *P. c. curryi**.

Hab. Sibudeni, Zululand. Alt. 1100 m.

Type. Male. B.M. no. 4.5.1.78.

The discovery and elucidation of this remarkably fine hare is a valuable result of Mr. Rudd's exploration of S. Africa, and one of special interest, as it forms a second species of the recently erected genus *Pronolagus*.

* Ann. Mag. N.H. (7) x. pp. 245-6 (1902).

Pronolagus ruddi would appear to be confined to a comparatively small area in S.E. Africa, while *P. crassicaudatus* in its different subspecies (*nyikæ*, *melanurus*, *curryi*, &c.) is spread over all South Africa, from Nyasa in the north and Namaqualand on the west to Wakkerstroom and Natal on the south-east.

"Zulu name 'Ntenetsha.'

"Rather uncommon. Frequenting the stony crests of the hills, but taking to the bush if pursued. As in other parts of South Africa, *Pronolagus* frequents one particular spot to leave its droppings and may sometimes be trapped there in consequence. The natives hunt this species incessantly."—C. H. B. G.

42. Procavia capensis Pall.

♂. 615. Sibudeni.

"Zulu name 'Imbile.'

"Uncommon—partly on account of its forming an article of food for the natives, and also because places suited to its habits are scarce in this district. It frequents the loose boulders under the krantzes, thickly overgrown with vegetation.

"Other specimens besides the one sent home were shot, but were not secured."—C. H. B. G.

43. Cephalophus natalensis Smith.

♂. 863, 877. Umvolosi.

"Zulu name 'Mkumbi.'

"This little buck seems to keep entirely to the coast-line of Zululand and Natal. It is rather local, but where found is common. It is strictly a bush-buck and in habits is very similar to the blue-buck, but perhaps is more partial to swampy ground."—C. H. B. G.

44. Cephalophus monticola Thunb.

♂. 674. ♀. 611, 616, 646, 662, 667. Sibudeni.

"Zulu name 'Impiti.'

"Very common in the bush, which it never leaves, even when hard pressed. It sleeps during the day under a fallen tree or in thick undergrowth in some dry place. When chased by a dog it invariably makes for the nearest sluit of running water and runs in the middle of it, going downhill. It makes a snuffling noise when running and a loud 'baa'-like cry when caught by a dog or badly wounded."—C. H. B. G.

45. Cephalophus grimmi Linn.

♂. 619. Jususie Valley.

♂. 794, 826. ♀. 809, 857. Umvolosi.

♂. 849. Hlatwa District.

"Zulu name 'Mpuusi.'

"This species and the Oribi are the only two open-country buck left in the greater part of the western districts of Zululand. The latter is now extremely rare and rigorously protected. Unlike

most South-African buck, the Duiker never stands when once put up until it is out of sight. To this it probably owes its existence in many parts, as a native will seldom risk wasting his powder and shot on a running object. It lies down during the day in the patches of thick grass on the hill-sides and feeds from sundown to just before sunrise. It is very destructive to pumpkins and sweet potatoes, but does not touch mealies."—C. H. B. G.

46. Raphiceros campestris Thunb.

♂. 803. ♀. 804, 810. Umvolosi.
♀. 847. Hlatwa District.

"Zulu name 'Nxiua.'

"Common, inhabiting the grassy flats and undulating open country. It is especially fond of lying in the long reddish grass in the dry vleys, probably because of the similarity of its own colouring."—C. H. B. G.

47. Cervicapra arundinum Bodd.

♂. —. ♀. 848. Hlatwa District.
♀. 801. Umvolosi.

"Zulu names 'Mplangu,' 'Sasako,' Sasogo,' and 'Umsigi.'

"Fairly common, frequenting the long grass on the flats and hill-sides and the deep reed-filled sluits. It is easy to approach and when flushed it stands and looks back before it has gone far. In this part of the country the does outnumber the bucks by quite six to one, owing to the latter having been killed out."—C. H. B. G.

48. Cervicapra fulvorufula Afzel.

♂. 845. Hlatwa District.

"Zulu name 'Nxala.'

"Fairly common. They keep entirely to the stony hill-sides and are not easy to approach. The most I saw together were four."—C. H. B. G.

49. Tragelaphus sylvaticus Sparrm.

♀. 668. Sibudeni.

EXPLANATION OF PLATE XVI.

Fig. 1. *Amblysomus iris* (p. 259). *a.* Upper view of skull. *b.* Left upper tooth-row, permanent dentition, from the type. *c.* The same, milk-dentition, from No. 874.

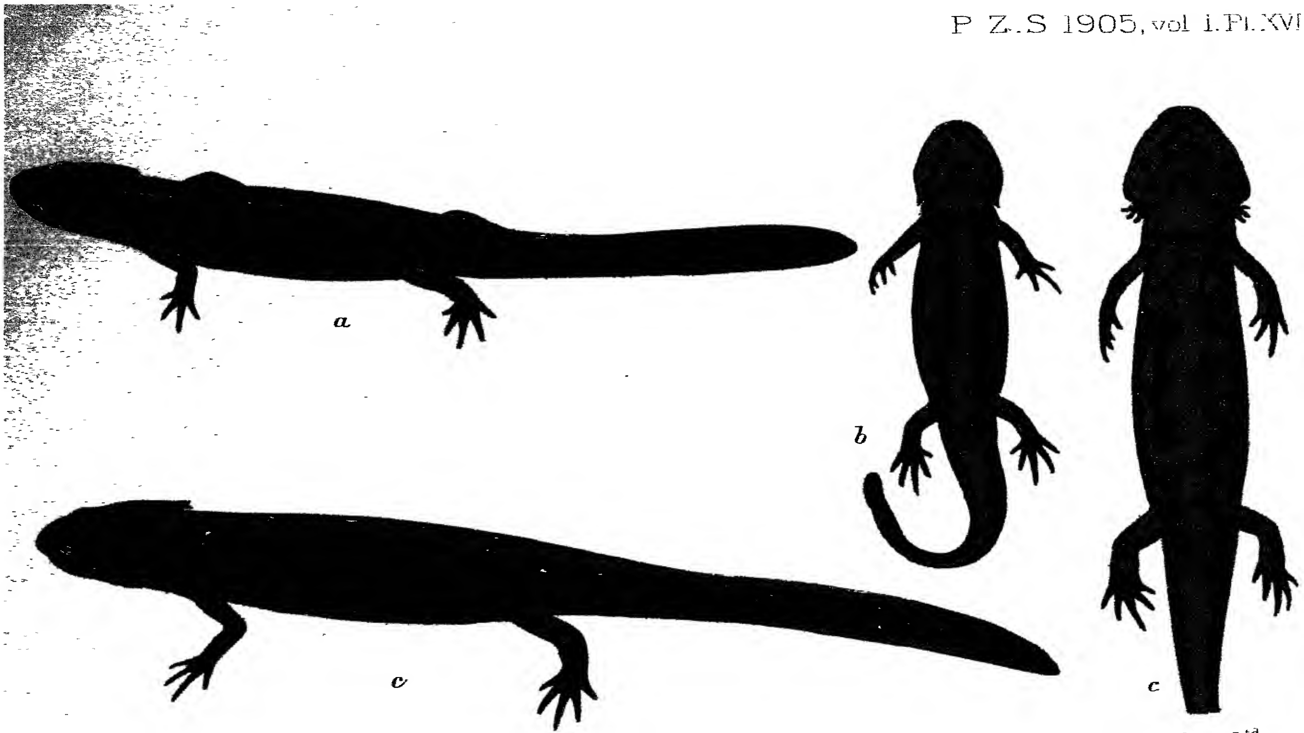
2. *Amblysomus chrysillus* (p. 261). *a.* Upper view of skull. *b.* Left upper tooth-row.

3. *Amblysomus corriæ**. *a.* Upper view of skull. *b.* Left upper tooth-row, permanent dentition. *c.* The same, milk-dentition.

4. *Pronolagus ruddi* (p. 272). Skull of type, lower aspect.

5. *Pronolagus crassicaudatus curryi* (p. 274). Skull of type.

* Thomas, Abstr. P. Z. S. No. 20, p. 5, 23rd May, 1905.



J. Green del. et lith.

MOLGE WOLTERSTORFFI.

Bale & Danielsson L^td imp

5. Description of a new Newt from Yunnan. By G. A. Boulenger, F.R.S., V.P.Z.S.

[Received April 13, 1905.]

(Plate XVII.*)

Mr. John Graham, who has made so many additions to our knowledge of the Reptiles, Batrachians, and Fishes of Yunnan, the latest of which is the remarkable Discoglossid described by me as *Bombinator maximus* †, has also obtained several examples of a new Newt, which I propose to name in honour of Dr. Wolterstorff, of Magdeburg, one of our Corresponding Members, who for some years has been engaged on a Monograph of the Tailed Batrachians of the Old World.

Molge wolterstorffi, sp. n. (Plate XVII.)

Fronto-squamosal arch bony, thick. A chevron-shaped series of palatine teeth, the apex on a line with the choanæ. Tongue small, subelliptical, the sides slightly free. Head without grooves, once and one-fourth to once and one-third as long as broad, its length contained three and two-thirds to four times in the length to base of tail; the greatest width of the head behind the eyes, which are rather small and feebly prominent; snout broadly rounded; labial lobes much developed. Body rounded in both sexes; no dorsal crest, no vertebral ridge. Limbs moderate; fingers and toes depressed, free; outer carpal and tarsal tubercles small but distinct, the latter sometimes very prominent. Tail strongly compressed, blade-like, with upper and lower crest, obtusely pointed, its length about that of head and body. Cloacal lips as in *M. vulgaris*. Skin perfectly smooth and shiny; a strong gular fold. Blackish olive above, with an orange or orange-vermilion vertebral stripe, with or without round or roundish spots or dots of the same colour; orange-vermilion beneath, with black spots or marblings, which may be confluent into longitudinal bands; lower edge of tail vermilion-orange.

	♂. mm.	♀. mm.
Total length	110	140
From snout to cloaca	55	70
Head	16	19
Width of head	12	15
Fore limb	19	22
Hind limb	22	24
Tail	55	70

Of the six specimens sent by Mr. Graham, all except the male

* For explanation of the Plate, see p. 278.

† Ann. & Mag. N. H. (7) xv. 1905, p. 188, pl. xiii

of which measurements are here given have preserved the external gills,—another instance of the neoteny already observed in Tailed Batrachians living at great altitudes. The altitude of Yunnan fu, where the specimens were obtained, is about 6000 feet. The skull in these branchiferous specimens is fully ossified and has all the features of the mature state. The female is full of ripe spawn.

In the structure of the skull and the absence of crest or digital web in the male this new species approaches the Spanish-Portuguese *M. boscæ* Lat., and the Chinese-Japanese *M. pyrrhogaster* Boie, the affinity of which I pointed out many years ago *.

EXPLANATION OF PLATE XVII.

Molge wolterstorffi, sp. n.

a. Male, natural size, side view.
b. Male, natural size, lower view.
c. Female, natural size, side view and lower view.

6. On Hybrid Hares between *Lepus timidus* L. and *Lepus europæus* Pall. from Southern Sweden. By Einar Lönnberg, C.M.Z.S., &c.

[Received February 21, 1905.]

(Text-figures 53 & 54.)

Among the sportsmen of Southern Sweden it has for several years been regarded as a fact, that hybrids were produced between the native Variable Hare of Scandinavia (*Lepus timidus* L.) and the Common Hare of Middle Europe (*L. europæus* Pall.), introduced for sporting purposes from Denmark or Germany. This opinion had not, however, been proved by any scientific investigation, and the question therefore remained open.

Hybrids between mammals living in an entirely wild state are, as is well known, exceedingly rare, although such among domesticated mammals, or even those kept only in confinement, are quite common as well as numerous with regard to the combinations. It seemed thus desirable to subject the supposed Hybrid Hares of Scania to a closer examination. For this purpose I tried to obtain further information about them and material for investigation †. Thanks to the kindness especially of Count Tage Thott and Count C. C. Beck-Friis, I have succeeded in getting several specimens, which proved to be hybrids, and the same and some other gentlemen furnished me with fresh material for comparison.

* Bull. Soc. Zool. France, 1880, p. 37.

† This material is now kept in the Swedish Museum of Natural History in Stockholm.

The first Hare I had the pleasure of receiving, and about the hybrid nature of which there cannot be the slightest doubt, was shot the 28th of October, 1904, by His Royal Highness Gustavus Adolphus at Skabersjö in Scania, on the rich and well-kept hunting-grounds of Count Tage Thott, and immediately sent up to the Swedish Museum of Natural History in Stockholm, where it is now mounted. It is a female of rather large size, measuring about 60 cm. from the snout to the root of the tail. The length of the head is about 11 cm. The length of the ears, measured from their base on the outer side, but without the hairs at their tips, is 129 mm. (or with the hairs 137 mm.), the length of the hind foot from the heel to the tip of the middle claws is 17 cm., and the length of the tail, not counting the hairs, 87 mm.

From these dimensions it may be seen that this Hare does not agree with *Lepus timidus* or with *L. europæus* with regard to such measurements that are of value for the distinction of these two species, viz., those of the ears, tail, and hind foot. The first two dimensions are plainly intermediate between the corresponding ones of the species of Hare mentioned above. The maximum length of the ear of *Lepus timidus*, measured as above, seems to be about 11½ to 12 cm., and the same dimension of *L. europæus* about 12 cm. The tail of the former without the hairs is about 60 to 72 mm., and of the latter 95 to 105 mm. The hind foot of *L. europæus* does not seem to exceed 150 mm., at least not much, when measured as above, while that of a full-grown *L. timidus* usually is from 160 to 165 mm. In this respect this hybrid specimen consequently has attained a larger size than either parental species.

A description of the colour of the hybrid reveals the double origin just as plainly as the measurements. It is almost completely still in its summer pelage, but the new winter coat is showing here and there. The nose is rust-coloured above as in *L. europæus*. The sides of the nose are lighter, partly whitish. The lips are whitish, light greyish in the middle; the chin and throat are white. The sides of the head and the nose are rust-coloured, but somewhat mixed with dark brown hairs. There is a darker vertical spot below the anterior angle of the eye. The anterior and upper vibrissæ are black, the lower and posterior white. The hairs of the forehead are dark brown with yellowish-white tips, the combination producing a general yellowish-brown colour. The anterior surface of the ears is quite similar to the forehead, the median surface rust-coloured; the posterior half and the base have assumed the winter coat and are white; the tip is margined with black, a 15 mm. broad black band extending about 27 mm. from the tip (including the hairs). The inside of the ear-conch is in the middle whitish, but the more conspicuous marginal parts are rusty yellow. The sides of the occiput from behind the eyes and below the ears rust-coloured mixed with white. The middle of the occiput, from behind the ears, and the

upper neck are white, but with the under-fur basally rusty yellow. The colour of the back is due chiefly to the longest hairs, which are dark brown with broad subapical rings of yellowish white. Nearly covered by these is a stratum of rust-coloured shorter hairs. The general colour of the upper parts of the body becomes through this arrangement greyish brown, lighter than the summer coat of *Lepus timidus*, but less rusty red than that of *L. europæus*.

The under-fur is white, and on the sides the winter coat has developed so far that here and there cloudy spots of white are visible, and the lower parts of the flanks are clouded by white nearly all over. The shoulders could almost be termed yellowish white, the thighs ashy grey ("blue") with intermixed dark hairs and a slight tinge of rusty. The under parts are white with a yellow stripe bordering the flanks. The fore legs and feet are light rust-coloured as in *Lepus europæus*, with white spots of the winter coat. The hind legs are as the thighs, only a little lighter, but the heel has a dark spot like the back. The hind feet are almost white on their upper surface, but some rust-coloured patches are left of the summer coat. The tail is white with a blackish-grey stripe above, better developed than in *Lepus timidus* but much less so than in *L. europæus*.

The chest is light brownish grey with the white winter coat showing through. The belly and inner side of legs are white.

The white "blue" winter coat is to be regarded as an inheritance from *Lepus timidus*, but it is evident that in the summer coat the head, neck, legs, and feet have had a colour that has agreed very well with that of *L. europæus*. Consequently it appears as if those parts which in summer are most like *Lepus europæus* in the winter become most like *L. timidus*, which is a rather interesting fact.

When skulls of these two species of Hares are compared with one another, the difference in the shape and size of the nasals is most conspicuous. Those of *Lepus timidus* are broader and shorter and form in the middle a rather broad, flattened area, from which the lateral parts are almost angularly bent and slope down towards the premaxillary. In *L. europæus* the upper surface of each nasal is evenly convex, and this results in making the groove between the nasals in the median line deeper than in the former species. The upper and lateral parts are also less defined from each other in this species. The nasals in the hybrid are quite intermediate in shape. The convexity is less pronounced than in *Lepus europæus*, but the median groove is deeper than in *L. timidus*, and so on. The greatest width of both nasals is contained fully twice or more in the greatest length of the same bones in *L. europæus*, but, as a rule, this is not the case in *L. timidus*, with which the hybrid agrees in this respect.

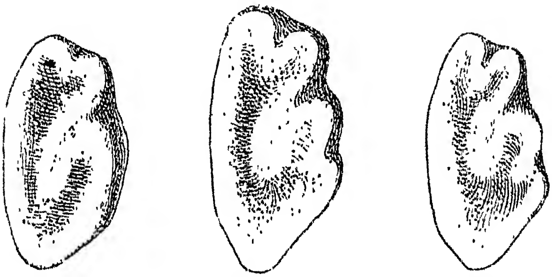
The zygomatic arches of *L. timidus* are more strongly developed and broader than in *L. europæus*. The shape of the anterior end

of each zygomatic arch is especially different in the two species. In *L. europæus* the distance from the anterior end of the deep groove for *musc. masseter lateralis (portio profunda)* to the anterior vertical border of the arch itself is greater than the height of the same portion of the zygomatic arch. In *L. timidus* the condition is quite the opposite, the height of the anterior portion of the zygomatic arch being greater than the distance from the anterior end of the groove or fossa mentioned above and the anterior border of the arch. In the hybrid the condition is intermediate, but nearer that of *L. timidus*. The anterior, inferior angle of the orbit in the hybrid has a structure which, singularly enough, differs from that of both parental forms. In both the latter the *jugale* and the lower part of the *processus spheno-orbitalis* of the maxillary project in such a way that a rather deep fossa is formed in the inferior anterior angle of the orbit between the bones mentioned and the alveolar protuberances. This fossa is, however, entirely missing in the hybrid. This depends evidently upon a different arrangement of the insertion of the muscles. In the parental forms, to judge from my material, the anterior portion of the *masseter lateralis* is confined to the interior surface of the zygomatic arch and its upper margin in the anterior corner of the orbit; but in the hybrid it spreads further forward on the facial area, where a tubercle and some rugosities indicate the limit of its insertion. The difference between the hybrid and the parental forms indicates accordingly an increase of a part of the masticating apparatus in the former. The very great development of the whole zygomatic arch of the same shows that other parts of the masseter as well have been enlarged to a considerable extent. The greatest height of jugal is in the hybrid 12·5 mm., while the greatest corresponding measurement for *L. timidus* is 10 mm., and for *L. europæus* only a little more than 9 mm., so far as my material goes. The *fossa pterygoidea* in the hybrid specimen is larger (its width being more than 8 mm.) than in either of the parental species, and its shape is intermediate: thus the *musculus pterygoideus internus* has a wider area of insertion in the hybrid than in the parental forms, and the great breadth of the *lamina lateralis* proves the same for the *m. pterygoideus externus*. The *sulcus temporalis* of the squamosum has in the hybrid almost the same shape as in *L. timidus*, that is to say deeper and narrower than in *L. europæus*.

The supraorbital processes are very strongly developed in the hybrid, but the frontal region of the skull behind the *processus supraorbitales posteriores* is very strongly constricted, not measuring more than 13 mm. This, which is the more striking when the great size of the skull is considered, I regard as an inheritance from *L. europæus*; as of ten skulls of *L. timidus* none is so narrow, the limits of variation being 15–19 mm. and the usual dimension 17 mm. In *L. europæus* the same dimension is in my material from 12 to 15 mm.

The foremost premolar of the maxillary is more simple in *L. europæus*, with, as a rule *, only two enamel-folds, while the same tooth in *L. timidus* has three. In this respect the hybrid resembles the latter species, as text-figure 53 shows. But the size of the teeth is, as also can be seen from the figure, larger than the average in the parental species.

Text-fig. 53.



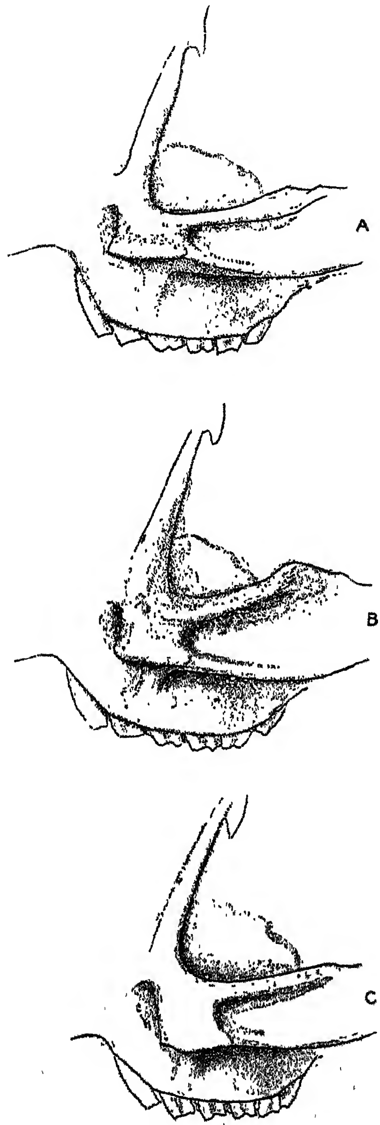
First premolar of the maxillary: A of *L. europæus*, C of *L. timidus*, and B of hybrid between both. (A and C 10 times enlarged, B 8 times enlarged.)

This description appears to be sufficient not only to prove the presence in the hybrid of characteristics from both the parental species, but also to show that the hybrid is physically very strongly developed, even more so in certain respects than either of the parents. The masticating-power of the hybrid appears to have been especially greatly developed, with a grinding-surface larger than the average in the parental species. This has needed a greater development of the muscles moving this apparatus, and with the increase in size of the muscles the bones standing in relation to them have become altered, which indicates how easily even such characteristics as those derived from the skull may become altered (see text-fig. 54, p. 283).

Two months later, when all the Hares, even in Scania, had assumed their winter garb, some more specimens were received from Count Thott. They all differed somewhat in colour. The two darkest had the fore-neck and breast, the colour extending even somewhat on the flanks, uniformly deep rusty red. The hairs of the upper parts were mostly black with broad subapical or apical bands of a rusty yellow. In these two specimens there were only very few traces of a lighter winter coat on the sides of the hind legs. The third was a little lighter and had a broad band above the tail on the lower back mixed with bluish grey. These three were no doubt true examples of *Lepus europæus*.—The fourth, however, seemed more than doubtful. It

* Indications of the third fold may, however, sometimes be seen.

Text-fig. 54.



Anterior part of the zygomatic arch: A of *L. europæus*, C of *L. timidus*, B of hybrid between both. (⅔ nat. size.)

was much lighter than the others. The general colour of the back is a sandy greyish yellow, produced by the pale yellow to whitish-yellow tips of the hairs which almost entirely conceal the next portions of the hairs which are dark brown. The under-fur is silky white. The sides of the breast have a silvery-white haze on a rusty ground-colour, produced by long white hairs and white tips to the other hairs, the lower portions of which are rusty. The lower neck and chest have a pale rusty-yellow ground-colour, which, however, is almost concealed, or at least veiled over, by very long white tips to the hairs. The head is like that of a *Lepus europæus* in its winter coat, but the white areas are more extended and more purely white, and the darker parts lighter, rust-coloured. The throat is pure white. The ears are somewhat lighter than those of *L. europæus.* The hind-neck is rust-coloured, much mixed with white. Hind-quarters and a portion of the lower back to an extent of 7 cm. are bluish ash-coloured. Fore legs rusty red in front, otherwise white; hind legs white with rusty patches. Tail white with a narrow stripe of greyish black above.

The dimensions of this Hare were:—Total length about 58 cm.; length of head $11\frac{1}{2}$ cm.; length of ears (measured as above) 13 cm.; hind foot 16 cm.; tail 10 cm. These measurements are partly intermediate between the average measurements for *L. timidus* and *europæus*, especially the length of the ears. The hind foot is nearly as large as in *L. timidus* and the tail as in *L. europæus.* These facts taken together with the colour indicate that this specimen is a hybrid. Such an opinion is also strengthened by an investigation of the skull. The greatest width of both nasals is contained more than twice in their length, as in *L. europæus*, but otherwise their general shape is intermediate. The height of the zygomatic arch is only 9 cm., but its foremost part in front of the deep groove for the insertion of *masseter lateralis* is almost higher than long, and differs in this respect from the condition found in *L. europæus.* The foremost premolar of the maxillary has three enamel-folds.

Although, as the description indicates, this specimen is a hybrid, it resembles *L. europæus* more than the former hybrid does, and it may therefore be possible that it is the product of a secondary crossing between a hybrid of the first degree and a specimen of *L. europæus.* No real proofs for such an hypothesis can be offered, but it is made probable *per analogiam* by the existence of other specimens which also may be supposed to be products of a secondary crossing, but in this latter case between hybrids of the first degree and *L. timidus.* The first of such specimens was received in the middle of January 1905, from the estate Vrams-Gunnarstorp in Scania, belonging to Governor Tornerhjelm. Its ears were intermediate in length and measured about 13 cm.* The tail was rather less than inter-

* I regret to say that the head of this specimen had been cut away in front of the ears, as is an old and habitual custom in Sweden, probably originally an act of superstition.

mediate, measuring only $7\frac{1}{2}$ cm., and the hind foot was 16 cm. In its general colour it resembles *L. timidus* (bluish-grey variety) more than the specimen described above, but there is, on the other hand, a very conspicuous inheritance from *L. europæus*. The back has a rusty-brown colour modified by whitish and yellowish hair-tips, but below these tips the hairs are not so dark as in *L. europæus*, and may be described as dirty umber-brown. On the sides of the breast the broad white or whitish-ashy tips dominate, and below them the hairs are rusty brown, and the under-fur is light rusty yellowish-grey. The chest is covered by very long white tips to the hairs, but below these the fur is pale rusty yellow, a certain inheritance from *L. europæus*. On the neck and round the ears the rusty colour is less concealed as the white tips are shorter. The flanks and hind-quarters are mostly bluish ash, perhaps with a rusty hue on the flanks. The same colour extends on the lower back about 12 cm. from the tail. The feet are coloured as in the foregoing hybrid specimen, but the tail is less grey above, although more so than in *L. timidus*. Still more like *L. timidus* was another hybrid presented by Count C. C. Beck-Friis, and shot at Börringe, in Scania, at the end of January 1905. The greater part of the body of this Hare is bluish ashy, but a large patch 18 cm. in length and 7 cm. in breadth on the back behind the shoulders is sandy brown. This colour is produced by a mixing of rusty yellow, white, and brown tips to the hairs, but below these tips the hairs are almost as dark brown as in *L. europæus*, from which it undoubtedly is an inheritance. Towards the periphery at the patch mentioned this colour becomes paler. The under-fur has a more or less rusty tinge all over the back. The hairs of the neck are rusty with white or ashy tips, and the hairs of the chest and lower neck are pale rusty yellow with long white tips to the hairs; but here, as well, the inheritance from *L. europæus* is quite conspicuous. Nose and forehead rusty; sides of the nose and the head and a broad streak behind the eye white, a patch below and behind the eye ashy grey. Ears rusty brown on the anterior side, black-tipped, and white behind; inside of the ear-conchs coloured as in *L. europæus*. Their length may be termed intermediate, as it measures 12·7 cm. The hind feet are also intermediate in length, measuring 15·8 cm.

The skull resembles most nearly *L. timidus* with regard to the shape and dimensions of the nasals and the zygomatic arch. There are three enamel-folds on the first premolar of the maxillary, but the third is not much developed and it resembles therefore the same in *L. europæus* *.

* [Since this paper was read I have had the opportunity of seeing another specimen of hybrid Hare which had been shot near Gothenburg. The "German Hares" introduced there had been obtained from Frankfurt-am-Main, where *Lepus europæus* assumes a more pronounced winter garb extending over the flanks and haunches. The Variable Hare has also in the neighbourhood of Gothenburg a lighter winter coat than in Scania, and is often quite white, consequently the hybrid Hare from Gothenburg was much lighter than the hybrids from Scania. It was almost white with a large brownish saddle-patch. The characteristic rusty

As the two specimens last described show mixed characters, derived from *L. europæus* as well as from *L. timidus*, their hybrid nature appears to be proved. But, on the other hand, as the characters derived from the Variable Hare are more dominating, there is a probability that they are products of a secondary crossing as alluded to above. If such a supposition be correct, the hybrids between the two species of Hare now living in Scania must be fertile with the parental stock. The genital organs of such specimens as I have had the opportunity of examining appeared to be quite normally developed and not at all smaller than in other Hares, when killed in the winter. As the two species are closely related, the interbreeding and the fertility of the hybrids do not appear to be unnatural or unexpected. It is nevertheless interesting to verify this.

Count Tage Thott informs me that it is a rather common occurrence, which he himself and his gamekeepers have observed many times, that Hares belonging to the two different species copulate with each other. It is evident from this that the two species have no antipathy, as sometimes is the case even between related species. The result of this must therefore be that hybrids are produced in such localities where representatives of both species meet. It is especially likely that a crossing may take place when either species has been introduced into a country formerly inhabited only by the other, as is the case in Southern Sweden. It also appears as if the opinion of the sportsmen there was correct, and that there is an actual occurrence of hybrid Hares in all degrees of mixing of both species. If then, as is supposed and also seems probable, the hybrids are fertile, the final result may be, either a new race which, so to say, swallows the two original species through unlimited intercrossing, or, may be, one of the races gains superiority over the other, the latter in course of time being eliminated and disappearing, while the former breeds true and becomes more and more pure again. At least in some places in Scania, as for instance at Skabersjö, the latter seems to be the case with *Lepus europæus*, or the "German Hare," as we call it in this country. Count Thott has told me that when this species had been recently introduced, such specimens as he regarded as hybrids were rather numerous, but later they have become more and more scarce, so that among the first two hundred Hares shot this last season only one (viz., the one first described in this paper) seemed doubtful; the others were considered

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colour of the under-fur of the chest, the broad black stripe on the comparatively very long tail, prove a certain amount of inheritance from *L. europæus*. The measurements and the characteristics of the skull indicate the hybrid nature of the specimen as well.

The differences between the specimens of *L. europæus* from Eastern Germany and those from Denmark alluded to above are rather striking, at least when both are in winter garb, the latter being much darker above and having the chest coloured with a deep rusty red. It appears, therefore, that the Danish Hares form a separate geographical race.

to be true *L. europæus*. Whether the condition is different at other places in Scania, I do not know.

The two species have not, as is well known, the same habits. The "German Hare" frequents open and cultivated fields, in which it seems to select and prefer the most fertile spots. The Variable Hare, again, gives preference to a landscape where forests or groves and shrub-covered hills alternate with pastures and cultivated fields*. These biological differences might perhaps result in a third kind of *modus vivendi*, viz., that either species may select its own suitable localities and "settle" there, without mixing any more with the other or interfering with the same on its own grounds, so to say. In such a way an explanation might be found for the fact that in other countries, where both these species of Hares occur side by side in a wild state, or where, at least partly, their areas of distribution overlap, so very few hybrid-crossings have been found, to judge from the available literature. Or is it probable that such hybrids are not so very uncommon? In such a case they must have been overlooked, for the literature concerning similar cases is very scanty.

In 'Zool. Garten' † O. von Loewis writes that he has seen at least a dozen such hybrids within 20 years in Livonia, and states that he has ascertained the correctness of this opinion through comparative measurements; but his narrative is confined to this, and he does not quote any measurements nor give any description.

In Switzerland it appears that hybrids have been found between the Common Hare (*L. europæus* Pall.) and the Alpine Hare (*L. varronis* Miller). At least parti-coloured specimens have been described as such by Tschudi and others. Captain Th. C. zu Baldenstein described 1863‡ a Hare which he had obtained in Dec. 1862 at Paspels in Switzerland, and which seems to have been most probably a hybrid, to judge from its colour and from the statement that the ears and tail were shorter than in *L. europæus*, with which the specimen otherwise agreed in size. There is, however, no description of the skull, so that it would have been fortunate if the case had been more fully proved, even if it must be admitted as very probable.

* From this may be concluded that the food chosen by the two species is somewhat different, and that of *L. europæus* probably more tender. This again may serve as an explanation of the differences in the development of the masticating-apparatus of the species in question, that of *L. europæus* being somewhat weaker, with narrower zygomatic arch, &c. (conf. above).

† Jahrg. 1877.

‡ Jahresber. d. naturf. Ges. Graubündens, n. F. viii. Jahrg.

7. On the Giant Eland of the Bahr el Ghazal, *Taurotragus derbianus gigas* (Heugl.). By A. L. Butler, F.Z.S., Superintendent of Game Preservation, Soudan.

[Received March 21, 1905.]

It is with great pleasure that I at last find myself able to give a fairly accurate description of the Giant Eland of the Bahr el Ghazal—the grandest of all African antelopes.

The name *Boselaphus gigas* was given to the Eland of this region by Von Heuglin in 1863, and was based only on a massive pair of horns which measured 35 inches in length and 32 inches between the tips. Later on, the observations of Schweinfurth proved that this Eland belonged to a striped form, but from that day until now no complete description of the animal has ever been recorded.

In the 'Book of Antelopes' this Eland is treated as a subspecies of *Taurotragus oryx*, but, naturally, no description of the animal being available, Messrs. Sclater & Thomas were very doubtful where to place it. Thus ('Book of Antelopes,' vol. iv. p. 199) they say:—"In these respects (the great size of the horns and the presence of white stripes) it would seem to approach *Taurotragus derbianus*, but Schweinfurth says nothing about the black neck of that species." And on p. 208 they remark:—"It may be identical with *Taurotragus oryx livingstonii*, but as Heuglin has given it a name we will allow him the benefit of the doubt for the present, and will call this northern striped form *Taurotragus oryx gigas* until further investigations have been made."

This name I have ventured to alter to *Taurotragus derbianus gigas*, as there is now no doubt whatever that the animal is no subspecies of *Taurotragus oryx*, but a very close ally of the West-African Eland. With this it agrees in its large, wide ears, in having the neck black with a sharply defined white posterior margin, in the black on the lower surface, in the stripes, and in the black patches above the inside of the knees. (These patches are present also in *T. oryx*, but absent or only faintly grey in *T. oryx livingstonii*, from which the Bahr el Ghazal Eland proves to be quite distinct.) Indeed, from *T. derbianus* the Soudan form seems to differ only in its much lighter body-colour (a pale "café-au-lait" fawn instead of a rich ruddy brown), in the greyish white of the black-maned dewlap, and in carrying even grander horns.

I have from time to time been able to examine nine pairs of horns of this Eland, and they are wonderfully large and massive. The finest pair I myself have handled measured 39¼ inches (straight) in length and 39 inches between the tips, but several of the other heads were very little inferior. It is probable that a length exceeding 40 inches is occasionally attained. What seem

to me typical horns are very straight, stout, and heavy, have the spiral ridges very strongly developed, and generally measure nearly as much between the tips as they do in length.

The first specimens of this Eland killed by an Englishman (to my knowledge) were shot about two years ago by Col.-Sergt. Boardman, Egyptian Army, in the country west of Dem Zubeir—just north of the 7th degree of N. latitude. The extreme thickness of the neck-skins proved too much for the worthy sergeant's taxidermic ability, and he managed to save only the skulls and horns. Beyond the facts that the animals were striped, that he could only just get his arms round their necks, and that he shot them in pyjamas from the door of his tent (!), I could not obtain much information from him.

About a year ago the late Captain Haynes, R.A.M.C., while accompanying a punitive expedition in the Niam-Niam country, wounded a bull, but had to leave the animal owing to want of time. A few days later the gallant officer received the wound which caused his death, subsequent to which the head of his Eland was recovered and brought in by natives.

In 1903 Mr. Leo Franco, an employé of the Forest Department, shot two bulls near old Wau, but also failed to preserve the thick skins; and quite recently three British officers have succeeded in shooting specimens only a short distance from Wau.

One of these fortunate sportsmen—Bimbashi Collins, Egyptian Army—has kindly sent me a letter containing a description and measurements of the two animals shot by him, and also their head-skins and hides to forward to England. From his letter, and from my examination of the skins, the following description (the credit for obtaining which belongs entirely to Bimbashi Collins) is drawn up:—

Description of Taurotragus derbianus gigas, *adult male.*

Height at withers 68 inches.

The frontal mat of hair dark chocolate brown, merging into the colour of the nose, which is black. Sides of the head light grey, becoming pale fawn-colour on the cheeks. From the anterior angle of each eye a narrow white stripe runs forwards and inwards, sharply defining the edges of the frontal mat. On each cheek, about 2 inches behind and rather below the eye, there is a circular white spot about an inch in diameter, surrounding two or three coarse black hairs an inch in length.

The upper lip and chin are white.

The ears are large and wide, externally mostly black, but with grey bases and conspicuous white tips; inside they are black and white. The large, pendulous dewlap is whitish grey, with a narrow mane of coarse black hair running below it from the throat to the chest, where it terminates in a large tuft. The hairs in this mane are from 2 to 4 inches in length; at the centre of the dewlap there is a small mingling of white hairs. The sides

of the neck are covered with longish, coarse hair, brown and black mixed. Round the base of the neck the hair becomes entirely black, forming a conspicuous collar about 8 inches wide. This is sharply separated from the colour of the body by a narrow half-collar of pure white, which extends from the chest tuft half way to the withers.

The body is very pale fawn-colour, almost (as Bimbashi Collins terms it) "café-au-lait," becoming white on the belly. On the white of the under surface there is a long black patch, commencing in a point between the fore legs and extending backwards to the navel. A black spinal stripe of longer hair runs the whole way along the neck and body, and from this about ten white stripes run down the sides and haunches. The hair of the body is very short, smooth, and sleek.

The limbs are pale fawn-coloured, like the body, white on the inner sides, with black patches at the back of the fetlocks and round the pasterns, and black patches 4 inches in length on the back of the fore limbs, just above the knees.

The following additional notes and measurements are from Bimbashi Collins's letter to me:—

"I killed one old solitary bull and one younger herd bull. In the herd which I saw I counted 50 horned heads and 10 calves running with them, and I am told there is another herd on the same ground. The horns of my lone bull I make out to be 39 inches, and those of the herd bull 38 inches, but I am not quite sure of my measurements.

"Dimensions of solitary bull were:—

Height from heel, leg in standing position, 5 ft. 8 in. (17 hands).
Nose to base of tail (along curves? A. L. B.) 9 ft.
Length of body, shoulders to hindquarters, 6 ft. 2 in.
Length of tail, 2 ft. 3 in.
Girth 6 inches behind shoulder, 7 ft. 1½ in.
Girth round centre of neck, 4 ft. 2½ in.

"In the herd which I stalked there was one bull which looked enormous, and must have had horns well over 40 inches, but I lost sight of him in the bush, and shot the younger bull in mistake for him.

"The animals were very tame, and were not much disturbed by my firing one shot, but the herd was spread out over so much ground that it was next to impossible to stalk any particular animal.

"According to natives, old bulls have a curious habit of rubbing the mat of hair on the forehead in the puddle made by their own urine. The old bull had damp mud on the forehead which smelt distinctly of urine. The young bull's forehead was dry and clean."

8. Notes on the Muscular and Visceral Anatomy of the Leathery Turtle (*Dermochelys coriacea*). By R. H. Burne, B.A., F.Z.S.

[Received March 20, 1905.]

(Text-figures 55–73.)

In May 1904 the Council of the Royal College of Surgeons obtained a specimen of the Leathery Turtle (*Dermochelys coriacea* L.) from Japan, with the object, mainly, of adding the skeleton to the Museum.

On account of the rarity of the animal, it was thought advisable to make also a careful dissection of the soft parts, more particularly of those that must of necessity be destroyed in the preparation of the skeleton.

The notes taken during this dissection, arranged for easy reference and collated with previous descriptions of the anatomy of the animal, form the contents of the present paper.

The specimen was a young female of the following dimensions:—

	centim.
Total length (following the curve of the carapace)..	135
Length (between the bases of the flippers)	68
Girth (under fore limbs)	135
Girth (midway between the limbs).....................	140
Girth (at base of hind limbs)	91
Length of fore limb, from its point of emergence from the body (following the outer curve).........	82
Greatest breadth of hand................................	20
Length of hind limb (tibial border)	33
Girth of head at hinder extremity of the gape	53
From point of snout to inner canthus of eye.........	8·5
From point of snout to nostril	2·5

In colour the animal was black above, blotched with irregular white spots, each of which measured on an average 1–2 cm. in diameter. The ventral surface of the body, limbs, and tail was dirty white, marked with irregular longitudinal bands and blotches of black.

The six longitudinal areas into which the carapace is divided by seven bony ridges are approximately of equal breadth—11 cm. in the middle of the trunk,—gradually narrowing towards the tail.

There are six rows of scutes half embedded in the thick plastral integument—a double row along the mid-line, with two single rows about 11 cm. apart on either side.

The true plastron-bones (text-fig. 57, p. 298) lie close beneath the deep surface of the integument, and form a ring whose lateral parts lie about half way between the mid-line and the lateral margin of the plastron. They do not seem to bear any particular relation as regards position to the superficial rows of scutes.

The ribs and the nuchal plate are embedded in the deep surface of the dense integumentary carapace. In a similar way, the dorsal parts of the dorso-lumbar region of the vertebral column are partially embedded in the deeper parts of the carapace as far back as the last ribs. The sacrum and tail are free. The sacral region had been injured by a spear-thrust and the surrounding parts were somewhat decayed, so possibly the freedom of the sacrum may have been artificial.

The Muscular System.

The muscles of the trunk of a young animal have been described by Rathke*, and those of the shoulder in another small specimen by Fürbringer †. As most authors, who have dealt with the muscles of Reptiles, have used different names for the same muscle, I have thought it best to adopt the names and numbers given by Hoffmann in Bronn's 'Thierreich' (Bd. vi. Abt. iii.)—in the first place because they do not carry with them any implied homology with the muscles of mammals, and in the second place because a full synonymy is given with each name and the comparison with other descriptions is thereby very much simplified. An exception has been made in the case of the hind-limb muscles, for which Dr. Gadow's ‡ names and numbers are used.

Muscles of the Head and Neck.

Squamoso-maxillaris (*depressor maxillæ*) (text-fig. 55. 11).—Origin: hinder edge of the squamosal. Insertion: ventral surface of the angle of the jaw.

A cylindrical muscle with fleshy origin and insertion. Separated at its origin into two parts by the insertion of a slip of the mylohyoid.

Dilator tubæ (text-fig. 55. 12).—Origin: squamosal, internal to origin of squamoso-maxillaris. Insertion: upon the external meatus.

Testo-occipitis (text-fig. 55. 13).—Origin: the anterior part of the nuchal plate, close to the mid-line. Insertion: the hinder edge of the parietal, 2 cm. from the mid-line.

A cylindrical muscle 2 cm. in diameter.

Testo-capitis (text-fig. 55. 14).—Origin: the carapace, along a line that slopes outwards from the point of the first rib to the second. Insertion: the hinder margin of the skull between the insertion of the testo-occipitis and the origin of the squamoso-maxillaris.

A very powerful muscle, with an extensive narrow origin.

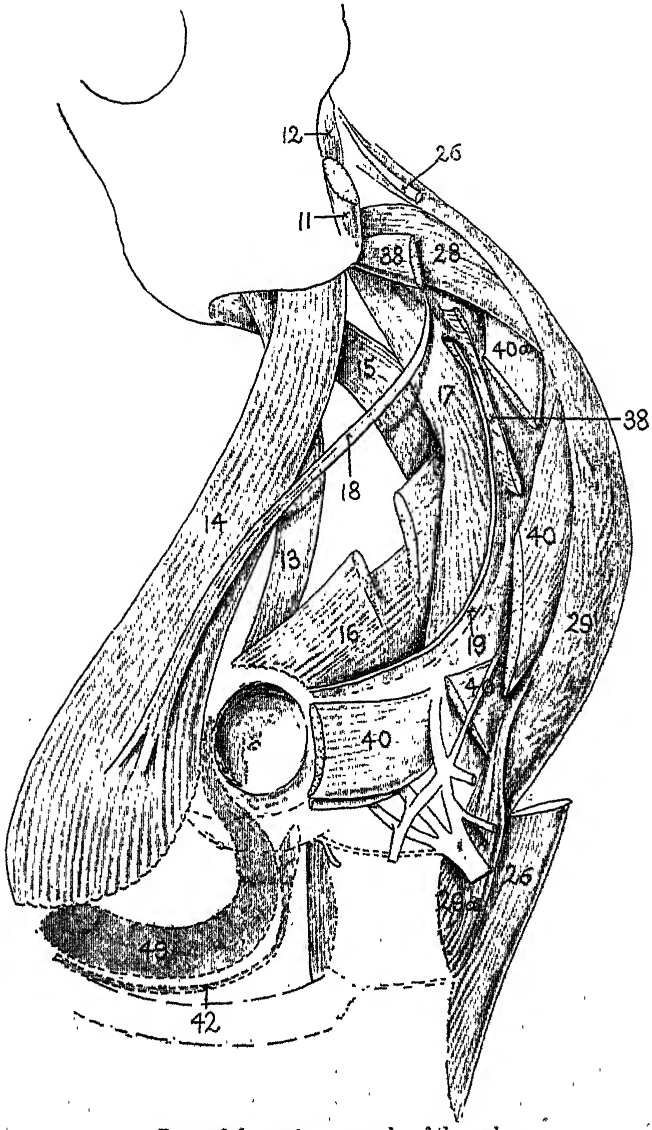
Cervico-capitis (text-fig. 55. 15).—Origin: the dorsal parts of

* Rathke: Ueber die Entwicklung der Schildkröten, 1848, p. 154.

† Fürbringer: "Zur vergl. Anat. der Schultermuskeln," Jena. Zeits. Bd. viii. 1874, p. 221.

‡ Gadow: "Beitr. zur Myologie d. hinteren Extremität der Reptilien," Morph. Jahrb. Bd. vii. 1882, p. 329.

Text-fig. 55.



Dermochelys coriacea, muscles of the neck.

11. Depressor maxillæ, 12. Dilator tubæ, 13. Testo-occipitis, 14. Testo-capitis, 15. Cervico-capitis, 16. Testo-cervicalis, 17. Transversalis cervicis, 18. Testo-cervicalis lateralis, 19. Sphincter colli, 26. Dorso-occipitis, 28. Collo-squamosus, 29. Longus colli, 38. Capiti-plastralis, 40. Collo-scapularis, 42. Testo-coracoideus, 49. Testo-humeralis dorsi.

vertebræ IV., V. Insertion: the hinder margin of the parietal between the insertion of the testo-occipitis and the mid-line.

This muscle usually takes origin from vertebræ III., IV., V. (Bronn's 'Thierreich,' Bd. vi. Abt. iii. p. 79.)

Testo-cervicalis (text-fig. 55. 16).—This muscle can be separated into a superficial and a deep part:—

(a) *Superficial part.*—Origin: the nuchal plate parallel to the anterior border of the scapular articulation. Insertion: the latero-dorsal parts of vertebræ III., IV., V., VI.

(b) *Deep part.*—Origin: the carapace along the median border of the scapular articulation. Insertion: dorsal surface of vertebræ V., VI., VII.

The two parts of the muscle form a very powerful mass, clearly separable in front and at their origin, but fused posteriorly. The muscle does not agree very well with the description of any of the neck-muscles given by Hoffmann in Bronn's 'Thierreich,' but most nearly resembles the testo-cervicalis, especially that of *Trionyx*, which rises from the nuchal plate and is inserted upon the 7th vertebra.

Transversalis cervicis (text-fig. 55. 17).—Origin: the lateral parts of vertebræ IV., V., VI., VII. above the transverse processes. Insertion: basioccipital and posterior zygapophyses of vertebræ I., II.

This muscle is the most lateral of the strictly dorsal neck-muscles. In other Chelonians it seems (Hoffmann, p. 80) to rise further forward and not to be inserted upon the skull.

Testo-cervicalis lateralis (text-fig. 55. 18).—Origin: by several flat strands from the deep surface of the testo-capitis near its origin. Insertion: by a round tendon to the transverse process of vertebra II. in conjunction with part of the sphincter colli.

Sphincter colli (text-fig. 55. 19).—A sheet of muscle that covers the front of the throat from the tip of the posterior cornu of the hyoid to the clavicle. It varies considerably in muscularity in different parts. At its anterior and posterior ends it is strongly muscular, but in its central parts almost entirely fibrous and quite thin. It is inserted along the sides of the cervical vertebræ from the II^nd^ backwards and to the inner anterior border of the scapula. I can find no mention of the sphincter colli being attached to the scapula in other Chelonians.

Mylo-hyoideus (19 *a*).—An anterior extension of the sphincter colli sheet. Insertion: into the whole length of the inner surface of the mandible, just ventral to the genio-hyoideus, and by a small separate slip into the squamosal in the middle of the origin of the squamoso-maxillaris.

Capiti-plastralis (text-figs. 55 & 59. 38).—A sheet of muscle covering the ventral surface of the throat deep to the sphincter colli. Insertion: the outer end of the clavicle, the lateral parts of vertebræ II., III., IV., and by a separate and very definite slip into the inner surface of the squamosal, just dorsal to the dilator tubæ.

The muscle can be separated into three strands. The most anterior is the part inserted upon the skull, and forms a very definite muscle that passes from the mid-line of the throat just internal to the middle cornu of the hyoid. The other two strands are thinner and less defined. All three parts form towards the mid-line of the throat a fairly continuous sheet, whose hinder part extends back beneath the clavicular portion of the deltoid to the clavicle.

Coraco-hyoideus (text-figs. 58–60. 20).—Origin: from the antero-dorsal border of the coracoid about its middle. Insertion: upon the ventral surface of the body of the hyoid. In its course it passes dorsal to the clavicle.

Coraco-ceratohyoideus (21).—This muscle was continuous with the longitudinal muscles of the œsophagus. No origin from the coracoid was seen (it may have been missed). Insertion: into the ventral surface of the body and middle and posterior cornua of the hyoid. It is stated (Hoffmann, p. 82) that this muscle is peculiar to *Chelone*.

Genio-hyoideus (22).—Origin: the anterior two-thirds of the inner surface of the mandible, just above the insertion of the mylo-hyoid. Insertion: upon the anterior border and ventral surface of the middle cornu of the hyoid.

Cerato-maxillaris (23).—Origin: the tip of the middle cornu of the hyoid. Insertion: upon the inner surface of the angle of the jaw, just above the insertion of the squamoso-maxillaris.

Ceratoglossus (24).—Origin: the ventral surface of the proximal end of the middle cornu of the hyoid. Insertion: into the tongue.

Dorso-occipitis (text-fig. 55. 26).—Origin: by tendon from the ventral surface of the second dorso-lumbar vertebra. Insertion: by a narrow tendon to the base of the skull 3·5 cm. in front of the foramen magnum.

A flattish muscle, lying just ventral to the roots of the brachial plexus. It passes dorsal to the outer end of the posterior cornu of the hyoid, and at this point forms a narrow tendon.

In most Chelonia (Hoffmann, p. 83) this muscle appears to have a more extended origin, including usually several dorso-lumbar vertebræ, as well as the ribs connected with them. In its insertion it resembles the dorso-occipitis of *Chelys* and *Chelemys*.

Collo-squamosus (text-fig. 55. 28).—Origin: from the lateral parts of vertebræ II., III. Insertion: upon the squamosal close above the dilator tubæ.

Longus colli (text-fig. 55. 29).—A complex mass of muscle covering the ventral surface of the cervical vertebræ. Upon its surface are a number of half independent tendinous slips. The detailed origins and insertions of its various parts were not made out.

There was no origin from the anterior ribs or nuchal plate such as seems to occur generally (Hoffmann, p. 84).

One muscle in the neck-region I have not been able to satisfactorily identify:—

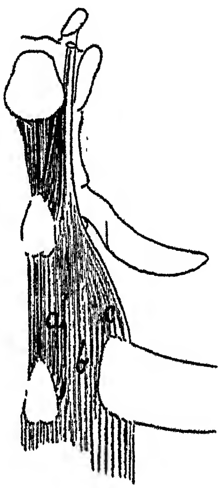
(Text-fig. 55. 29 *a.*) Origin: from the ventral surface of the last cervical and first dorso-lumbar vertebræ. Insertion: upon the ventral and lateral surfaces of vertebræ IV., V., VI., VII.

This muscle, the front end of which lies lateral to the longus colli, can be separated with difficulty into at least three more or less separate bellies.

Vestigial Back-Muscles. (Text-fig. 56.)

The dorsal surface of the dorso-lumbar region of the vertebral column is covered by a layer of intermingled muscular and tendinous tissues that represents the back-muscles in a degenerate condition.

Text-fig. 56.



Dermochelys coriacea, anterior part of the vestigial muscles of the back.

In this mass three parts can be distinguished by their position, although they are in no other way separable from one another:—

a. Fibres running from spine to spine. These parts are contiguous in the mid-line, except where they are interrupted by the neural spines.

b. Fibres that run beside the neural arches above the necks of the ribs.

c. Fibres running from rib to rib.

In front of the second pair of ribs these parts can be to a certain extent separated mechanically.

In the anterior thoracic region parts *b* and *c* are strongly

muscular, and in front form a rounded tendon that runs forward above the transverse process of the last cervical vertebra towards the anterior cervical vertebræ. Its insertion was, unfortunately, not seen. Posteriorly, this mass is attached partly to the second rib, partly to the sides of the second dorso-lumbar vertebra, and partly goes on directly above the neck of the second and succeeding ribs. Part *a* (interspinales) in this region forms a definite strand of muscle running between the spines of the last cervical and first two dorso-lumbar vertebræ.

These degenerate muscles could not be followed beyond the sacrum, owing to injury of that part, but behind the ninth rib they showed no signs of diminution, so that probably, as in very young animals, they passed on over the sacrum.

In Chelonia in general these muscles terminate from the second to the eighth ribs in the adult, while the interspinales are entirely lost.

As regards these muscles, therefore, *Dermochelys* is less specialised than the rest of the Chelonia. And as the degeneration of the back-muscles is due to the immobility of the carapace, we may infer that the relative softness of the carapace in *Dermochelys* is a primitive condition—a stage in the development of a true carapace, and not a secondarily acquired softness brought about by retrograde modification of a hard carapace.

Muscles of the Shoulder Girdle and Fore Limb.

Collo-scapularis (text-figs. 55 & 60. 40).—Origin: from the lateral parts of vertebræ III., IV., V., VI., VII. Insertion: upon the median border of the scapular fossette and upon the median surface of the head of the scapula.

This muscle is separated by the roots of the brachial plexus into four layers. The insertion does not agree with that given by Fürbringer for *Sphargis* and *Chelone*.

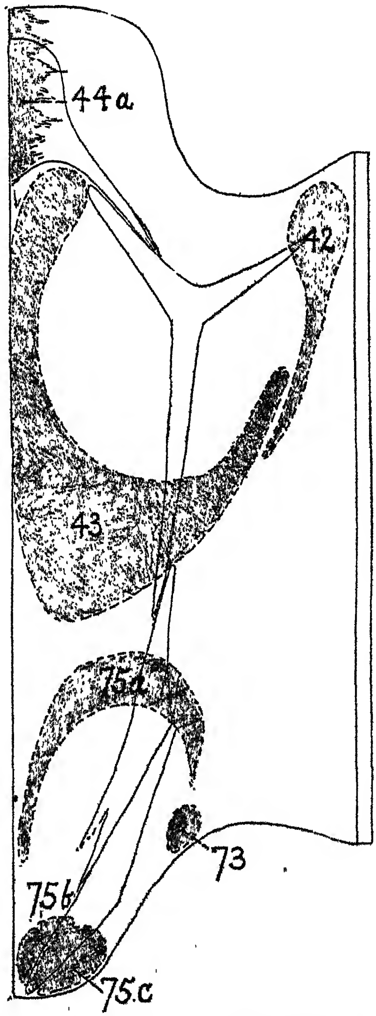
Another muscle (text-figs. 55 & 59. 40 *a*), which I cannot very satisfactorily identify, may possibly be part of the collo-scapularis. It takes origin from the lateral parts of the second vertebra in forward continuation of the preceding muscle, and is inserted upon the upper end of the scapula just dorsal to the insertion of the posterior part of the sphincter colli.

Testo-coracoideus (text-figs. 55, 57, 58, & 60. 42).—Origin: the plastron, along a line that runs diagonally forward and outward along the posterior edge of the outer part of the origin of the pectoralis, and thence passes behind the arm to the carapace and along the anterior border of the second rib to the hinder margin of the scapular fosette. The origin from the plastron is fleshy, from the border of the rib tendinous.

Insertion: fleshy, to the deep surface of the posterior half of the inner end of the coracoid, and by thin tendinous aponeurosis along the coraco-clavicular ligament and down the inner border of the scapula very nearly to its dorsal end.

The part of this muscle that rises nearest the vertebral column and is inserted upon the extremity of the scapula corresponds, I think, to the testo-scapularis of Fürbringer. This part, by its thickness and fleshy structure, could be distinguished from the

Text-fig. 57.



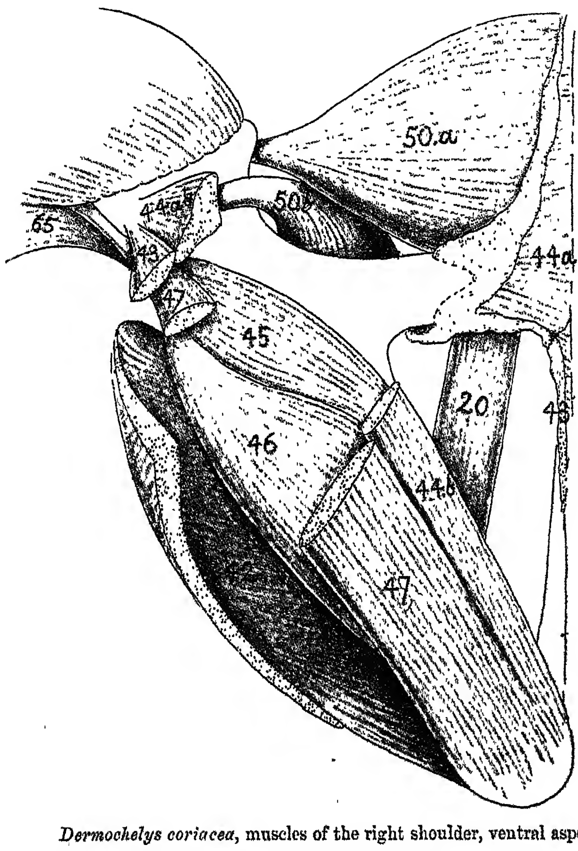
Dermochelys coriacea, inner surface of the plastron.

42. Testo-coracoideus, 43. Pectoralis, 44 *a*. Supra-clavicularis, 73. Obliquus abdominis internus, 75. Rectus abdominis.

rest of the scapular portion of the testo-coracoideus, although it seemed to be continuous with it.

Pectoralis (text-figs. 57 & 58. 43).—Origin: from the plastron by a large anteriorly concave semilunar attachment, the middle (longest) arm of which extends from 13 cm. behind the anterior

Text-fig. 58.



Dermochelys coriacea, muscles of the right shoulder, ventral aspect.

20. Coraco-hyoideus, 42. Testo-coracoideus, 43. Pectoralis, 44 *a*. Supra-clavicularis, 44 *b*. Supra-coracoideus, 45. Coraco-brachialis brevis externus, 46. Coraco-brachialis brevis internus, 47. Coraco-antebrachialis, 50 *a* & *b*. Deltoideus. 65. Humero-digiti I.-V. volaris.

border of the plastron to 11 cm. behind its mid-transverse line. The muscle-fibres converge towards the shoulder. Insertion: by mixed tendon and muscle upon the lateral process of the humerus

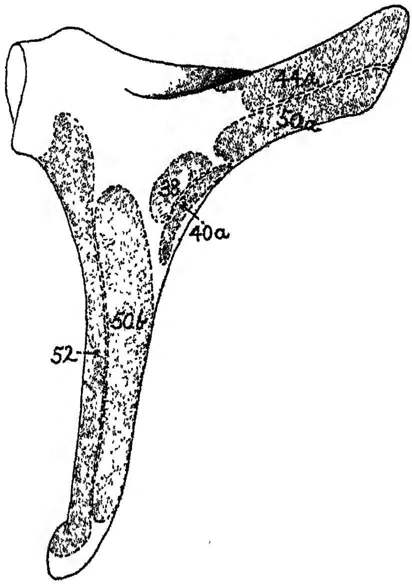
in conjunction with the tendons of the supra-clavicularis and supra-coracoideus.

Fürbringer states that in *Chelone* and *Sphargis* the tendon of the pectoralis divides into two, one of which extends on to the radius. I did not see this part of the tendon in my specimen.

Supra-clavicularis (text-figs. 57–61. 44 *a*).—Origin: from a median raphé and the plastron in front of the clavicle; from the anterior, ventral, and posterior surfaces of the clavicle. Insertion: upon the lateral process of the humerus.

This is a very large mass of muscle, measuring, at 6 cm. from its insertion, 10 cm. × 2 cm. Towards its insertion its deeper parts blend with the supra-coracoideus. Fürbringer states that this muscle is weak in *Sphargis*, but peculiarly strong in *Chelone*.

Text-fig. 59.



Dermochelys coriacea, left shoulder-girdle, anterior view.

38. Capiti-plastralis, 40 *a* (see text), 44 *a*. Supra-clavicularis, 50 *a*. Deltoideus (clavicular part), 50 *b*. Deltoideus (scapular part), 52. Scapularis.

Supra-coracoideus (text-figs. 58 & 61. 44 *b*).—Origin: from the anterior margin and median end of the dorsal and ventral surfaces of the coracoid. Insertion: upon the lateral process of the humerus.

This is a relatively thin sheet, separable at its origin with some difficulty from the coraco-antebrachialis.

Coraco-brachialis brevis externus (text-figs. 58, 61, & 64. 45).—

Origin: from the ventral surface of the outer third of the coracoid. Insertion: upon the humerus in the hollow between the lateral and median processes, just proximal to the insertion of the pectoralis.

A thin sheet of muscle capping the shoulder. The median nerve follows its hinder border, lying between it and the coraco-brachialis brevis internus.

Coraco-brachialis brevis internus (text-figs. 58, 60, 61, & 64. 46).—Origin: from the outer three-fourths of the hinder border of the coracoid, encroaching somewhat upon both dorsal and ventral surfaces. Insertion: upon the processus medialis of the humerus.

An undetermined muscle (text-figs. 60 & 62. 46 *a*), probably a separate part of the coraco-brachialis brevis internus. Origin: from the ventral and posterior border of the coracoid, extending slightly on to the coraco-scapular ligament. Insertion: upon the extensor surface of the median process of the humerus between the insertions of the coraco-brachialis brevis internus and of the subscapularis.

Coraco-antebrachialis (*biceps*) (text-figs. 58, 61, & 64. 47).—Origin: from the median end of the ventral surface of the coracoid, posterior to the origin of the supra-coracoideus. Insertion: by a round tendon to the heads of the radius and ulna.

This muscle passes into the arm between the head of the humerus and the median process, overlying the median nerve. As it enters the arm it forms a single rounded tendon that extends to the hollow of the elbow. Here, the tendon unites to a great extent with the dense connective tissue upon the surface of the humero-radialis longus dorsalis, but strands can be traced to both the ulna and radius. Fürbringer describes a separation of the muscle into definite superficial and deep parts during its passage along the humerus.

Humero-antebrachialis inferior (text-fig. 64. 48).—Origin: from the flexor surface of the humerus distal to the lateral process. Insertion: by tendon upon the flexor surface of the head of the ulna, in common with the tendon of the biceps.

Testo-humeralis dorsi (*latissimus dorsi*) (text-figs. 55 & 62. 49).—Origin: from the carapace along the anterior border of the second rib just in front of the testo-coracoideus, and along the outer margin of the scapular fossette to the posterior limit of the nuchal plate. Insertion: upon the middle of the extensor surface of the humerus between the insertion of the subscapularis and the origin of the anconæus.

Fürbringer states that in *Chelone* (adults) the origin of this muscle extends back to the third rib, but that this is a backward migration that takes place after embryonic life.

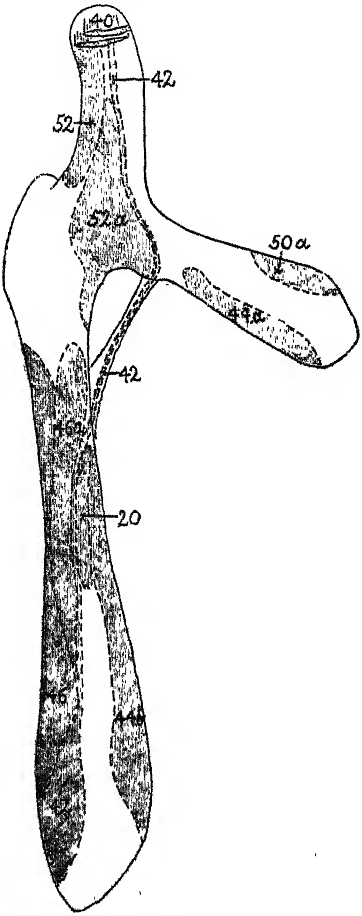
Scapulo-claviculo-plastro-humeralis (*Deltoideus*) (text-figs. 58, 59, & 62. 50).—This consists of two entirely independent muscles:—

a. *Pars claviculo-plastro-humeralis.*—Origin: from a median ventral raphé in front of the shoulder-girdle and from the anterior

and dorsal surfaces of the median half of the clavicle. Insertion: upon the extensor surface of the humerus, close to the insertion of the latissimus dorsi.

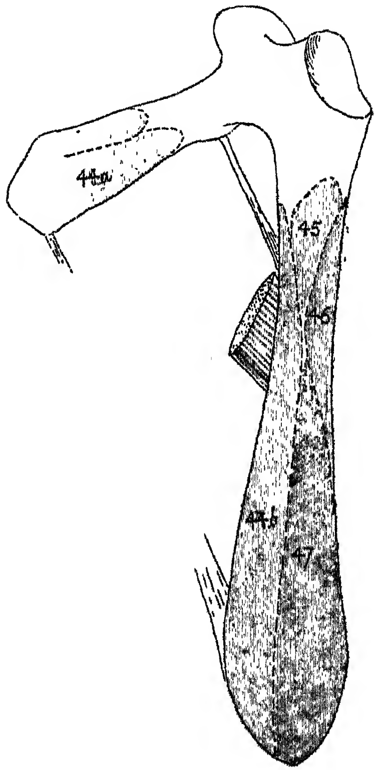
The tendon of this part of the muscle overlies a bursa as it passes over the anterior edge of the humerus.

Text-fig. 60.



Dermochelys coriacea,
right shoulder-girdle, dorsal view.

Text-fig. 61.



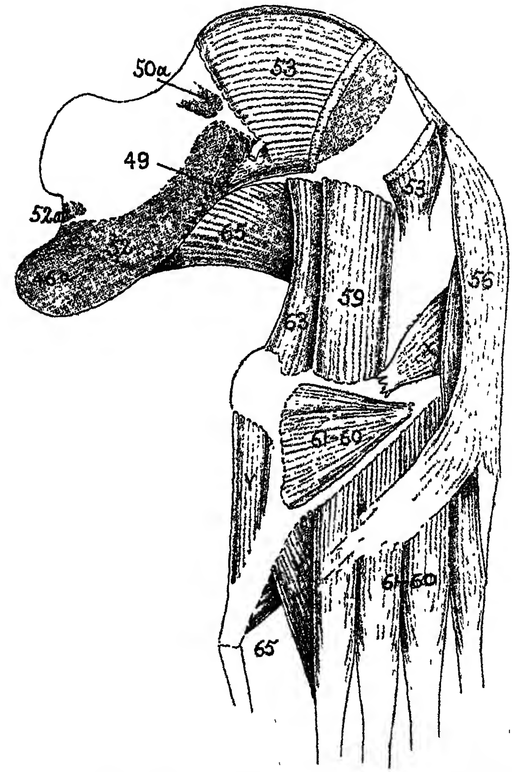
Dermochelys coriacea,
left shoulder-girdle, ventral view.

Text-fig. 60.—20. Coraco-hyoideus, 40. Collo-scapularis, 42. Testo-coracoideus, 44 *a*. Supra-clavicularis, 44 *b*. Supra-coracoideus, 46. Coraco-brachialis brevis internus, 46 *a*. (see text), 50 *a*. Deltoideus (clavicular part), 52. Subscapularis, 52 *a*. (see text).

Text-fig. 61.—44 *a*. Supra-clavicularis, 44 *b*. Supra-coracoideus, 45. Coraco-brachialis brevis externus, 46. Coraco-brachialis brevis internus, 47. Coraco-antebrachialis.

b. *Pars scapulo-humeralis* (text-figs. 58, 59, & 64. 50 *b*).—Origin: from the whole anterior surface of the scapula. Insertion: by a round tendon to the proximal parts of the processus lateralis humeri—in a position on the flexor surface of the humerus exactly opposite that occupied by the insertion of the pars claviculo-plastro-humeralis on the extensor surface.

Text-fig. 62.



Dermochelys coriacea, right fore limb, extensor surface.

46 *a*. (see text), 49. Testo-humeralis dorsi, 50 *a*. Deltoideus (clavicular part), 52. Subscapularis, 52 *a*. (see text), 53. Anconæus, 56. Humero-carpali-metacarpalis I., 59. Ulna-carpo-ulnaris, 60, 61. Ulna-carpo-radialis + carpali digiti I.–V. dors., 63. Humero-carpali-ulnaris, 65. Humero-digiti I.–V. volaris, X ulna-carpalis, Y intrinsic hand-muscles.

Fürbringer mentions that in *Chelone* and *Sphargis* these two parts are more independent than usual, but states that both are inserted upon the processus lateralis humeri.

The two parts together form a very large mass of muscle.

Subscapularis (text-figs. 59, 60, & 62. 52).—Origin: from the whole length of the outer surface of the scapula and partly also from the anterior and posterior surfaces. Insertion: along the extensor surface of the humerus from the median process to the origin of the anconæus. Fürbringer gives an origin also from the inner surface of the scapula.

A muscle (text-figs. 60, 62, & 64. 52 *a*) I was unable to determine, but probably a separate part of the subscapularis. Origin: from the posterior surface of the scapula (except its dorsal third). It passes behind the outer end of the coracoid, and is inserted between the median process and the head of the humerus.

Anconæus. Pars anconæus humeralis (text-fig. 62. 53).—Origin: from the distal half of the extensor surface of the humerus. Insertion: upon the head of the ulna.

Fürbringer speaks of this muscle as taking origin equally from both sides of the humerus. In my specimen, the flexor surface of the humerus was occupied by the origin of the humero-radialis longus dorsalis.

Humero-radialis longus dorsalis (text-figs. 63 & 64. 55).—A large but thin sheet of muscle that arises from the radial half of the flexor surface of the humerus distal to the lateral process, and extends on the radial side of the forearm to the wrist.

The surface of the muscle is covered by a layer of dense connective tissue, but by cutting this away three fairly distinct muscle-bellies can be made out. From the ulnar side these are: (1) a part united by fibrous tissue to the tendon of the biceps, and inserted just to its radial side upon the head of the radius; (2) a part extending down the flexor surface of the radius and inserted about its middle; (3) a part closely applied to the outer border of the anconæus, and inserted upon the whole of the radial and part also of the extensor surface of the radius down to the wrist.

Humero-carpali-metacarpalis I. (text-figs. 62 & 63. 56).—Origin: from the outer condyle of the humerus, between the anconæus and the humero-radialis longus dorsalis. Insertion: upon the head of metacarpal I., and to the back of the hand by a tendinous expansion that runs diagonally towards the little finger. Hoffmann gives an insertion for this muscle in other Chelonia upon the radius and carpus.

Ulna-carpo-radialis + *Carpali digiti* I.–V. *dorsalis* (text-figs. 62 & 63. 60+61).—Origin: from the inner surface of the ulna, from the ligaments of the extensor surface of the wrist, and from the greater part of the extensor surface of metacarpals I.–IV. Insertion: by a slip into the head of metacarpal I., and by flat tendons into the distal phalanges of digits I.–IV. and into metacarpal V.

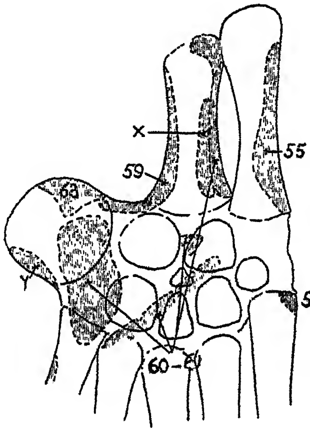
This is a thin muscle-sheet of very degenerate character, especially towards the ulnar side of the hand. Its tendons are bound closely to the periosteum of the finger-bones and can have little or no play. It corresponds fairly to the above-mentioned muscles of Hoffmann. The part proper to digit V. forms, however, a

completely separate muscle, that rises from the wrist proximal to the origin of the part proper to digit II., and thence runs almost directly outwards to the head of metacarpal V. and the pisiform. I saw no signs of a humero-digiti I.–V. dorsalis (extensor communis).

Ulna-carpo-ulnaris (text-figs. 62 & 63. 59).—Origin: from the inner condyle of the humerus. Insertion: upon the proximal edge and flexor surface of the pisiform and to most of the inner surface of the ulna.

This does not agree in detail with Hoffmann's description of the muscle in other Chelonia, but from its position and attachments is evidently an extensor carpi ulnaris.

Text-fig. 63.



Dermochelys coriacea, muscle-attachments upon the extensor surface of the forearm and hand.

55. Humero-radialis longus dorsalis, 56. Humero-carpali-metacarpalis I., 59. Ulna-carpo-ulnaris, 60, 61. Ulna-carpo-radialis + carp. dig. I.–V., 63. Humero-carpali-ulnaris, X ulna-carpalis, Y intrinsic muscles of hand.

(*Ulna-carpalis*) (text-figs. 62 & 63, X).—Origin: from the inner surface of the shaft of the ulna beneath the ulna-carpo-radialis. Insertion: into the skin of the wrist above the origin of carpali-digiti V.

This is a small muscle running diagonally towards the little finger. I could find nothing in Bronn to correspond with it, so have called it ulna-carpalis.

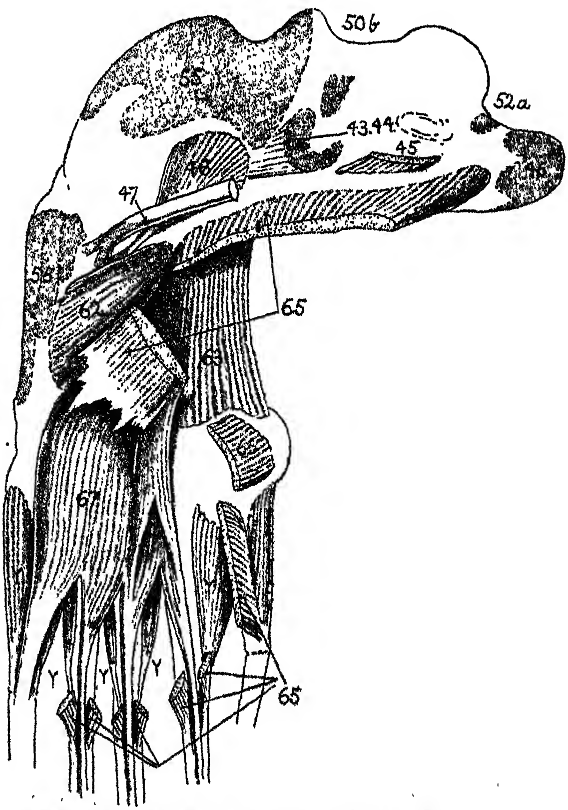
Humero-radialis volaris (text-fig. 64. 62).—Origin: from the flexor surface of the inner condyle of the humerus. Insertion: upon the inner surface of the shaft of the radius, passing superficial to the tendon of the humero-antebrachialis inferior.

Humero-carpali-ulnaris (text-figs. 62–64. 63).—Origin: from the ulnar border of the humerus proximal to the origin of the

ulna-carpo-ulnaris. Insertion: upon the proximal edge of the pisiform, extending onto its flexor and extensor surfaces.

Humero-digiti I.–V. *volaris* (text-figs. 62 & 64. 65).—Origin: from nearly the whole length of the ulnar edge of the humerus, passing at the proximal end somewhat onto the flexor surface alongside the median nerve. Insertion: partly into the dense fibrous tissue that covers the flexor surface of the wrist, and partly (by its ulnar side) into the deep flexor, contributing to form the tendons for digits III. & IV.

Text-fig. 64.



Dermochelys coriacea, right fore limb, flexor surface.

45. Coraco-brachialis brevis externus, 46. Coraco-brachialis brevis internus, 47. Coraco-antebrachialis, 48. Humero-antebrachialis inferior, 50 *b*. Deltoideus (scapular part), 52 *a*. (see text), 55. Humero-radialis longus dorsalis, 62. Humero-radialis volaris, 63. Humero-carpali-ulnaris, 65. Humero-digiti I.–V. volaris, 67. Flexor digitorum profundus, Y intrinsic hand-muscles.

The distal part of this muscle is represented by an independent short flexor sublimis. Origin: from the dense fibrous tissue that

covers the flexor surface of the wrist and partly from the outer side of metacarpal I. Insertion : upon the penultimate phalanges of digits II., III., IV., and upon the flexor surface of the pisiform and of metacarpal V. The parts of the muscle proper to digits II., III., IV. are perforated by the tendons of the deep flexor.

Ulna-digiti I.–V. (*Flexor digitorum profundus*) (text-fig. 64. 67).—Origin : from the whole length of the flexor surface of the ulna and from that of the ulnar half of the carpus exclusive of the pisiform. Insertion ; by four round tendons to the terminal phalanges of digits I.–IV.

Intrinsic muscles of the hand (text-fig. 64, Y).—These are seven in number. They take origin from the distal parts of the flexor surface of carpus and are inserted upon the metacarpo-phalangeal joints. There are two in connection with the thumb, very much matted together and partly fused with the tendon of the deep flexor ; one to the second digit, having a common origin with the outer one of the two to the thumb ; two to the third digit ; and one each to the outer side of digits IV., V.

Abdominal Muscles.

Rectus abdominis (text-figs. 57, 65, 66. 75).—*a*. Anterior part. Origin : from the plastron about 4 cm. behind the pectoralis by a backwardly concave semilunar attachment. Insertion : into the anterior margin of the lateral horn of the pubis. The insertion encroaches somewhat upon both dorsal and ventral surfaces of the pubis.

b. Inner posterior part. Origin : from the hinder edge of the plastron close to the mid-line. Insertion : upon the anterior end of the epipubis.

c. Outer posterior part. Origin : from the hinder edge of the plastron to the outer side of the origin of "*b*." Insertion : upon the ventral surface of the lateral horn of the pubis posterior to the insertion of "*a*."

The anterior part is a large fan-shaped muscle, the outer parts of which are lost in the loose skin of the groin. The two posterior parts are ribbon-shaped and fairly stout. The part "*b*" does not tally with any part of the rectus abdominis described by Gadow*, but I think it must be regarded as forming part of this muscle-sheet.

Obliquus abdominis internus (text-figs. 57 & 67. 73).—Origin : from the plastron close outside the lateral part of the origin of the anterior rectus abdominis, and from the loose skin of the groin. Its fibres run inwards and forwards dorsal to the thigh and are inserted upon the dorsal posterior border of the lateral horn of the pubis.

Transversus abdominis (74).—A very small muscle-sheet lying between the lateral parts of the obliquus internus and the perito-

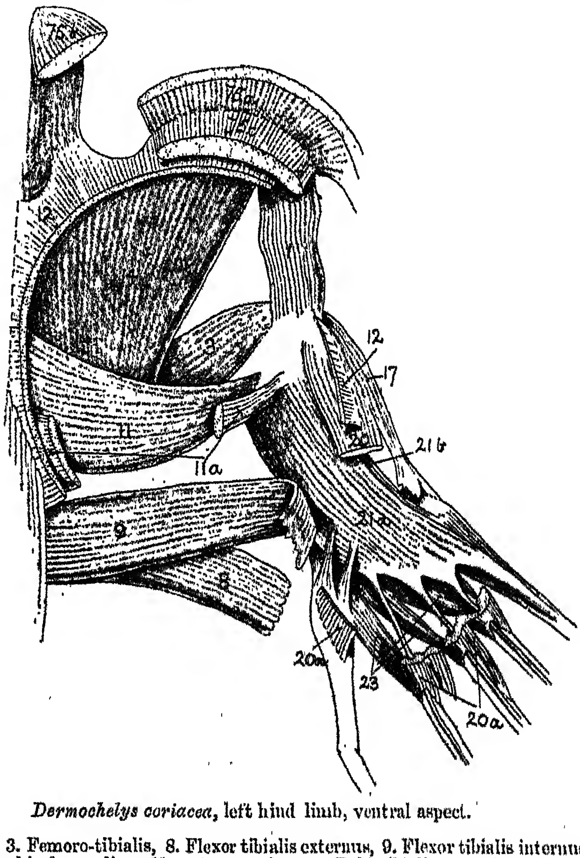
* Gadow : "Untersuchungen über die Bauchmuskeln der Krokodile, Eidechsen und Schildkröten," Morph. Jahrb. Bd. vii. (1882) p. 57.

neum. Its fibres run forward and towards the mid-ventral line. The dorsal limit (origin) of this muscle was not clearly seen.

Muscles of the Hind Limb.

Ambiens (text-figs. 65, 67. 1).—Origin: from the outer extremity of the upper surface of the lateral horn of the pubis. Insertion: into the superficial fascia upon the inner surface of the knee proximal to the insertion of the pubi-tibialis.

Text-fig. 65.



Dermochelys coriacea, left hind limb, ventral aspect.

1. Ambiens, 3. Femoro-tibialis, 8. Flexor tibialis externus, 9. Flexor tibialis internus, 11. Ischio-femoralis, 11*a*. (see text), 12. Pubi-tibialis, 14. Pubi-ischio-femoralis externus, 17. Tibialis anticus, 20. Gastrocnemius, 20*a*. Perforated flexors, 21*a*. Flexor longus digitorum, 21*b*. Tibialis posticus, 23. Flexores breves, 75. Rectus abdominis.

The tendon of insertion is usually (Hoffmann) combined with that of the femoro-tibialis.

Extensor ilio-tibialis (text-fig. 67. 2).—Origin: outer surface of the head of the ilium, distal to the origin of the ilio-fibularis. Insertion: to the outer side of the knee-joint.

Femoro-tibialis (*extensor cruris*) (text-figs. 65–67. 3).—Origin: from the anterior (extensor) surface of the proximal three-fourths of the shaft of the femur. Insertion: upon the head of the tibia.

The proximal part of this muscle is divided into two heads by the insertion of the pubi-ischio-femoralis externus.

I could not distinguish the separate parts (vastus externus and internus and cruræus) mentioned by Gadow.

Ilio-fibularis (text-fig. 67. 4).—Origin: from the ventral part of the outer surface of the head of the ilium. Insertion: to the outer side of the fibula just above the ankle.

Ilio-femoralis (text-fig. 67. 5).—Origin: from the anterior and outer surfaces of the ilium in posterior continuation of the origin of the pubo-ischio-femoralis internus, and also from the carapace (?) or vertebral column (?) just in front of the sacro-iliac articulation. This part of the muscle was damaged, so that its exact attachment is doubtful. Insertion: upon the outer side of the neck of the femur, in outward continuation of the insertion of the pubi-ischio-femoralis internus.

Flexor tibialis internus (text-fig. 65. 9).—Origin: destroyed on both sides, probably from the vertebral column close behind the ilium. Insertion: to the inner side of the tibia, in common with the distal part of the pubi-tibialis.

Flexor tibialis externus (text-fig. 65. 8).—Origin: destroyed, probably from the vertebral column in the neighbourhood of the origin of the flexor tibialis internus. Insertion: into the tegumentary fold between the tail and the heel, on a level with the ankle.

Ischio-femoralis (text-figs. 65–67. 11).—Origin: from the deep surface of the posterior half of the raphé of origin of the pubi-tibialis, and from the ventral surface of the ischium. Insertion: upon the distal three-fourths of the posterior and inner surfaces of the femur.

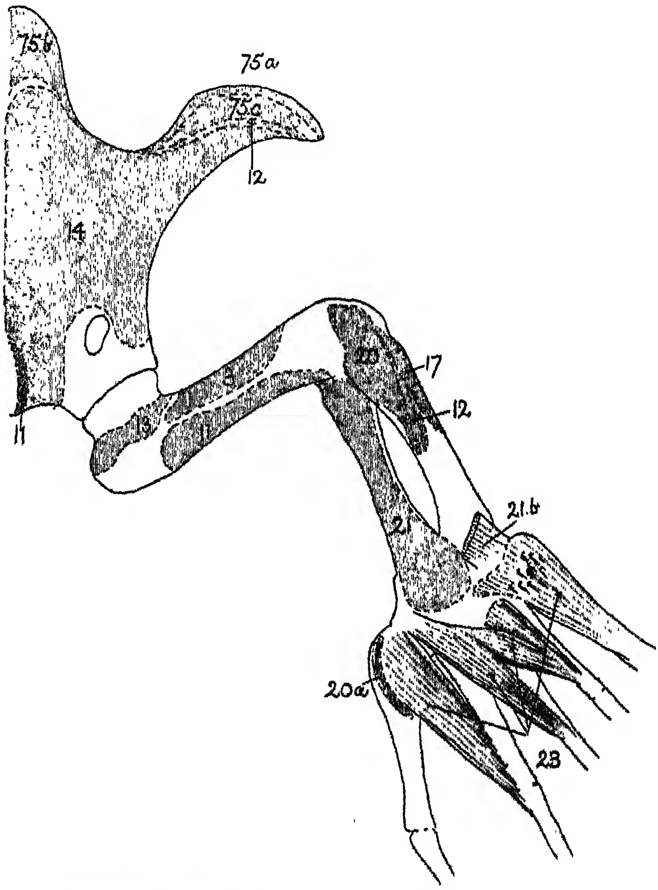
A separate portion of the *Ischio-femoralis* (text-fig. 65. 11 *a*).—Origin: from a median raphé behind the ischium, in common with the pubi-tibialis. Insertion: by a round tendon into the flexor surface of the capsule of the knee-joint.

Pubi-tibialis (text-figs. 65 & 66. 12).—Origin: in a continuous line from the ventral surface of the lateral horn of the pubis posterior to the insertion of the rectus abdominis; from the margin of the pubo-epipubic notch; by tendinous fibres from the epipubic part of the pubi-ischio-femoralis externus; from a median raphé extending back to the ischium; from the ischial symphysis and from a short post-ischial median raphé. Insertion: upon the ventral and inner side of the tibia from the distal limit of the insertion of the ambiens half way along the shaft. The upper part of the insertion is attached to superficial fascia only.

This muscle is indistinctly separable into two parts comparable to the ischio-tibialis and pubi-tibialis of Hoffmann (Bronn's 'Thierreich,' Nos. 86, 87).

In *Chelone* there is apparently no origin from the lateral horn of the pubis.

Text-fig. 66.



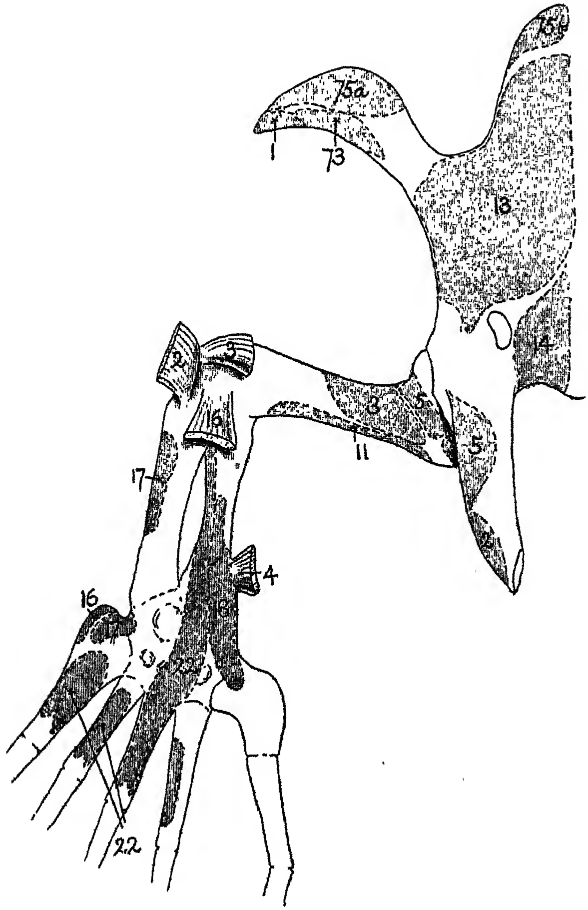
Dermochelys coriacea, muscle-attachments to the left hind limb.

3. Femoro-tibialis, 11. Ischio-femoralis, 12. Pubi-tibialis, 13. Pubi-ischio-femoralis internus, 14. Pubi-ischio-femoralis externus, 20*a*. Perforated flexor V, 21. Flexor longus digitorum, 21*b*. Tibialis posticus, 23. Flexores breves, 75. Rectus abdominis.

Pubi-ischio-femoralis internus (text-figs. 66, 67. 13).—Origin: from the greater part of the dorsal surface of the pubis from the

pubo-epipubic notch to the obturator foramen. Insertion: upon the inner half of the neck of the femur, continuous upon the anterior edge of the bone with the ilio-femoralis.

Text-fig. 67.



Dermochelys coriacea, muscle-attachments to the dorsal surface of the left hind limb.

1. Ambiens, 2. Extensor ilio-tibialis, 3. Femoro-tibialis, 4. Ilio-fibularis, 5. Ilio-femoralis, 11. Ischio-femoralis, 13. Pubi-ischio-femoralis internus, 14. Pubi-ischio-femoralis externus, 16. Extensor longus digitorum, 17. Tibialis anticus, 18. Peroneus, 22. Extensor brevis II.–IV. + Extensor Hallucis proprius, 73. Obliquus abdominis internus, 75. Rectus abdominis.

This muscle answers to the pubic part of Gadow's pubi-ischio-femoralis internus.

Pubi-ischio-femoralis externus (text-figs. 65, 66. 14).—Origin: from the whole ventral surface of the pubis and epipubis between the insertion of the epipubic part of the rectus abdominis and the origin of the pubi-femoralis and the obturator foramen; from the ventral surface of the ischium between the obturator foramen and the mid-line; and from the dorsal surface of the ischium and the root of the ilium. Insertion: upon the tuberosities of the femur, just distal to the posterior third of the neck.

The part of this muscle that arises from the dorsal surface of the ischium and from the ilium is probably the representative of Gadow's pubi-ischio-femoralis posterior.

This muscle, with the pubi-ischio-femoralis internus and the ilio-femoralis, forms a thick continuous muscular sheath around the hip-joint.

Extensor longus digitorum (text-fig. 67. 16).—Origin: from the external condyle of the femur covered by the insertion of the extensor ilio-tibialis. Insertion: by tendinous expansion to the extensor surface of metatarsals IV. and V., in conjunction with the peroneus; by tendinous slips between each of the four inner toes on the level of the metatarso-phalangeal joints; and by a strong tendon to the inner margin of the head of the first metatarsal.

The insertion is less definite than that described for this muscle in other Chelonia.

Tibialis anticus (text-figs. 65 & 67. 17).—Origin: from the upper two-thirds of the inner (radial) margin of the radius. Insertion: upon the extensor surface of the head of metatarsus I. and also by a tendinous expansion to the fibrous tissue on the flexor surface of the ankle.

Peroneus (text-fig. 67. 18).—Origin: from the distal half of the extensor surface of the fibula and from the extensor surface of the fibular side of the tarsus. Insertion: upon metatarsals IV. and V. The radial side of this muscle is continuous with the deeper parts of the extensor longus digitorum.

Gastrocnemius (text-fig. 65. 20).—Origin: from the inner condyle of the femur and from the inner and flexor surfaces of the shaft of the tibia, around the insertion of the pubi-tibialis.

At the heel the muscle is transformed into a dense sheet of fibrous tissue, from which arise in the sole of the foot the superficial (perforated) flexors of the digits.

The gastrocnemius has also direct attachments to the base of metatarsal I. and to metatarsal V.

Perforated flexors (text-fig. 65. 20 *a*).—Origin: from the fibrous expansion of the gastrocnemius. Insertion: into the first phalanx of digits I. to IV. These small muscles surround the tendons of the deep flexor and are inserted directly into the periosteum.

Flexor longus digitorum (text-figs. 65 & 66. 21).—Origin: from the hinder (flexor) surface of the internal condyle of the femur, from the whole flexor surface of the fibula, and from the proximal half of the fibular side of the tarsus.

Towards its distal end the muscle divides in two fairly distinct sheets :—

a (superficial). Giving off four rounded tendons inserted respectively into the distal parts of the four inner toes. The tendons towards their ends blend with the periosteum so that their exact point of insertion is not definite.
b (deep). Inserted upon the tibial side of the heel.

The superficial part is the deep flexor proper, the deeper layer is Gadow's tibialis posticus.

Two small slips, to which I can find no reference, pass from the surface of the deep flexor (just above the ankle) to the base of metatarsus V.

Extensor brevis II.–IV. + *Extensor hallucis proprius* (text-fig. 67. 22).—Origin: from the inner border of the shaft of the fibula and extensor surface of the tarsus in a line with digit III., and from the extensor surface of metatarsals I., II., III., IV. Insertion: by tendons that gradually fuse with the periosteum to the terminal phalanges of digits I., II., III., IV.

Flexores breves (text-figs. 65 & 66. 23).—Five small muscles inserted upon the base of the first phalanges of digits I., II., III., IV. Origin :—

i. From the radial side of the tarsus, it is partly fused with the deep flexor.
ii. By two heads, one from the head of metatarsus II., the other from the fibular margin of the tarsus.
iii. From the fibular margin of the tarsus.
iv. From the head of metatarsus V.

There is no *interosseus cruris*, which in *Chelone* is a very strong muscle.

Eye.

The eyelids (text-fig. 68) have the same general form and structure as those of *Chelone*. Their inner surface, and more especially that of the nictitating membrane, is deeply pleated. The pleats, or rather laminæ, lie close together like the leaves of a book and run approximately parallel to the margins of the lids. The basal parts of each lamina are the seat of smaller secondary pleats.

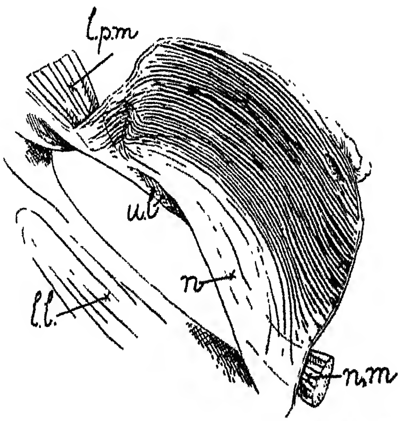
In *Chelone* there is a somewhat similar but relatively extremely feeble pleating of the conjunctival surface of the lids, and in this case the epithelium that covers the ridges consists almost entirely of mucous cells. It seems probable that in *Dermochelys* also the object of the pleating is to extend the mucous secreting surface.

The contents of the orbits were decayed, with the exception of the bulbus oculi, but a large mass of granular greasy débris was most probably the remains of an enormous lacrymal gland such as that found in *Chelone*. The globe of the eye measures 55 mm.

in transverse diameter × 26 mm. in depth. Its hinder parts are encased in a thick cartilaginous sclerotic, which thins out anteriorly where it meets the circlet of sclerotic bones.

The latter resemble those of *Chelone* in form, number, size, and arrangement, but are stouter.

Text-fig. 68.



Dermochelys coriacea, lids of the left eye seen from within.

l.l. lower lid, *l.p.m.* levator palpebræ muscle, *n.* nictitating membrane, *n.m.* nictitator muscle.

The outer parts of the sclerotic cartilage are hyaline, but towards the inner surface it gets more and more fibrous, the inner parts consisting of fibrous tissue interspersed with small and scattered centres of cartilage formation.

The lens, like that of *Chelone*, is relatively very small; it measures 7 mm. in the antero-posterior and 7·5 mm. in its transverse diameter.

The Alimentary System.

The general anatomy of the alimentary canal has been accurately described by Rathke*, and more recently by Vaillant†. The following additions may be made to their accounts of these organs.

The Œsophagus.

(R. C. S. Museum, Physiol. Series 461 B, C, & D.)

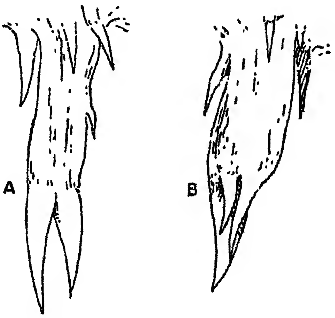
The horn-capped processes that beset the inner surface of the œsophagus are of all sizes. The larger ones average about 4 cm. in length, and, except in the pharyngeal region, are set so close

* Rathke: "Ueber die Luftröhre, die Speiseröhre und den Magen der *Sphargis coriacea*," Arch. f. Anat. u. Physiol. 1846, p. 292.

† Vaillant: "Remarques sur l'appareil digestif et le mode d'alimentation de la Tortue luth," Comptes Rendus Ac. Sci. t. cxxiii. 1896, p. 654.

together that their backwardly directed points form practically the whole of the exposed inner surface. Between the larger processes and upon their bases are smaller ones of various sizes. The processes are different in shape in the various regions of the œsophagus. Near the pharynx they have a spur-like, slender, and slightly flattened form and are always single. Further down they become far stouter with a thick conical point, and are often bifid or even trifid (text-fig. 69). The horn cap has a very definite

Text-fig. 69.



Dermochelys coriacea, œsophagus.

A. Bifid process from the middle part.
B. Trifid process from the lower end.

limit towards the base of the process, beyond which the surface of the shaft is relatively soft and more or less wrinkled. In *Chelone*, so far as I have seen, the processes are far more regular in form and are always single.

Stomach and Intestine.

The tubular part of the stomach (R. C. S. Museum, Physiol. Series 516 A) is partially divided into compartments by thirteen or so low irregular transverse folds, none of which is, however, sufficiently marked in this specimen to warrant the expression "diaphragms perforated in their centre" used by Vaillant in his description of them. The inner surface of the stomach is smooth.

The intestine (text-fig. 70, *int.*) passes at first in an anterior direction from the pylorus to the median border of the left lobe of the liver. It then turns to the right along the dorsal surface of the isthmus to the outer border of the right lobe. The bile and pancreatic ducts open into this transverse segment, and here also lies the transversely elongated pancreas, as in *Testudo*. Near the outer border of the right lobe of the liver, the mesentery increases very much in extent and the gut is thrown into numerous coils, that occupy the right side of the abdominal cavity.

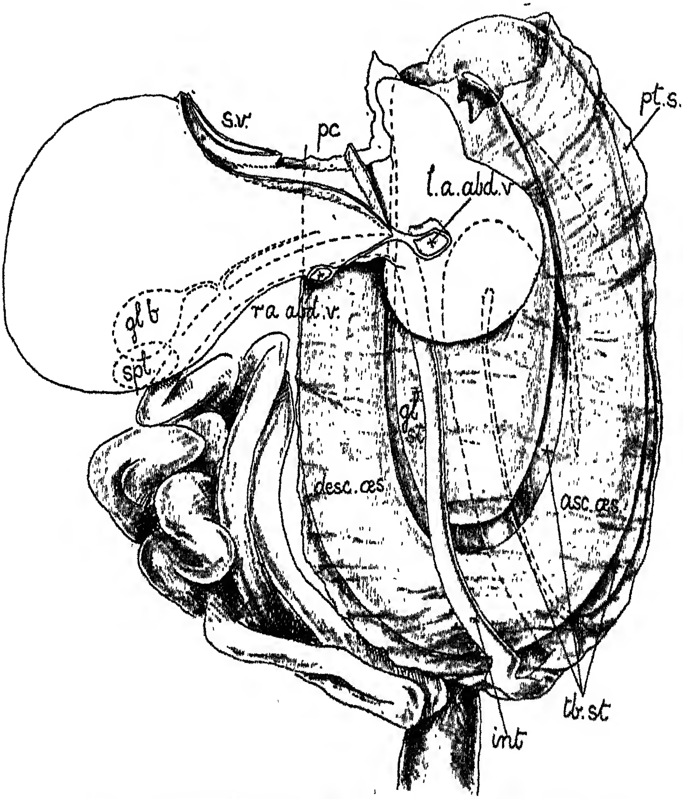
The small rounded spleen (text-fig. 70, *spl.*) is lodged in a fold of the peritoneum at the root of this mesentery under cover of

the apex of the right lobe of the liver. It has a similar position in *Emys* and *Testudo*.

The lining membrane of the first fourteen feet of the intestine is strongly reticulated, as in *Chelone imbricata* (Bronn's 'Thierreich,' Bd. vi. pl. 38. fig. 1).

The last thirty-two inches form the rectum, distinguished by a finely villous lining.

Text-fig. 70.



Dermochelys coriacea, abdominal viscera seen from the ventral aspect.

asc.œs. ascending limb of œsophagus, *desc.œs.* descending limb of œsophagus, *gl.b.* gall-bladder, *gl.st.* globular part of stomach, *int.* intestine, *l.a.abd.v.* left anterior abdominal vein, *pc.* pericardium, *pt.s.* peritoneal sac, *r.a.abd.v.* right anterior abdominal vein, *s.v.* sinus venosus, *spl.* spleen, *tb.st.* tubular part of the stomach.

The Liver. (Text-fig. 70.)

The liver consists of a large right and a smaller left lobe united by a narrow transverse isthmus, and thus has very much the same form as that of *Testudo*.

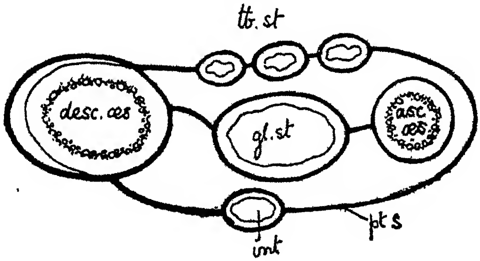
The gall-bladder lies half embedded in the deep surface of the right lobe, just distal to the attachment of the duodenal mesentery. A very short common bile-duct, formed by the union of the cystic duct with an hepatic duct coming from the left lobe, enters the wall of the intestine slightly to the left of the gall-bladder.

The duct does not, however, open into the intestine here, but runs on, as a dilated channel 15 mm. in diameter, for another 9 cm., away from the pylorus, and there opens by a long slit-like mouth bordered by foliate lips. A similar arrangement of the bile-duct has been briefly described by Temminck *.

The Mesenteries.

When the body-cavity is opened along the ventral surface, the coils of the small intestine are seen lying to the right and the œsophagus, stomach, and first part of the intestine to the left. The coils of the intestine are suspended by a sheet of mesentery in the ordinary way, but the complex on the left is apparently enclosed almost completely within a loose peritoneal bag (text-fig. 70, *pt.s.*). The relations of this bag to the various parts of the alimentary canal in connection with it were not determined in every particular, but so far as seen were as follows:—

Text-fig. 71.



Dermochelys coriacea, diagrammatic transverse section through the mid-region of the peritoneal sac.
Letters as in text-fig. 70.

The descending œsophagus when it enters the abdominal cavity is surrounded by a loosely fitting layer of splanchnic peritoneum. Along the dorsal and ventral surfaces of the œsophagus this layer gives off a pair of mesenteric sheets that form by their union a closed sac (text-fig. 71, *pt.s.*). In the dorsal wall of the sac are suspended the coils of the tubular stomach, and in its ventral wall the first segment of the small intestine. Free, within its cavity, lie the ascending arm of the œsophagus and the globular region of the stomach suspended by a mesentery given off from the left surface of the descending œsophagus.

* Temminck: Fauna Japonica (Reptilia), 1838, p. 6.

Anteriorly, part of the ventral wall of the sac is attached to the dorsal surface of the left lobe of the liver in continuation of the mesentery of the transverse segment of the intestine and also to the lateral border of the liver. Otherwise, the anterior attachments of the sac were not very satisfactorily made out, but in all probability it merges with the peritoneum that lines the anterior end of the abdominal cavity. Another detail that does not appear so clearly in my notes as I could wish, is the exact point at which the œsophagus comes to lie entirely free within the sac.

In *Emys*, although there is no similar sac of anything like these dimensions, there is an arrangement of the mesenteries that seems to represent it in a very much less developed condition. The œsophagus and stomach are suspended from the deep surface of the liver by a mesentery continuous with that which supports the transverse segment of the small intestine. This is no doubt comparable to the ventral wall of the sac in *Dermochelys*. But there is also a more dorsally placed and much looser sheet of mesentery that extends from the peritoneal lining of the anterior parts of the abdominal cavity to the stomach and lower end of the œsophagus. This, which I take to represent the dorsal wall of the sac, encloses between itself and the first-mentioned mesentery a deep pouch that lies behind the liver in the bend formed by the œsophagus, stomach, and intestine, but does not enclose within its cavity any free parts of the alimentary canal. The great development of this mesenteric sac in *Dermochelys* is most probably to be referred to the excessive length and bent form of the œsophagus and to the much complicated stomach.

Ten inches beyond the point of entry of the bile-duct into the intestine wall, a free mesenterial fold appears upon the anti-suspensory surface of the gut. The line of attachment of the fold is at first rather to one side of the mid-ventral line of the intestine, and in this part the fold is deep, and owing to the shortness of its free border compared with the length of its attachment forms a pouch in which are contained three coils of the gut. Beyond the region of the pouch the fold rapidly diminishes in depth and continues along the ventral surface of the intestine for some 16 inches. It terminates by branching off to either side to lose itself in the dorsal mesentery. In the angle between these two terminal folds is a small pigmented nodule, which may possibly be an extremely vestigial Meckel's diverticulum. I can find no indication of this ventral mesentery in *Emys*.

Food.

With the exception of the mouth, in which there was a small Teleostean fish, the only part of the alimentary canal that contained food was the tubular region of the stomach. In this part there were numerous tests of compound Tunicates, several small simple Ascidians, and a small piece of seaweed.

In the specimen examined by Vaillant there were in the stomach remains of *Hyperia galba*, fragments of Medusæ, as well as 20 grms. of plant-débris. I have also come across a statement in Tickell's 'Reptilia' that, according to Audubon, the food of this Turtle consists of Mollusks, Fishes, Crustaceans, Sea-urchins, and various marine plants.

Its diet appears, then, to be chiefly animal.

Organs of Circulation.

The Heart.

The heart agrees with that of other Chelonia in all essential characters. It differs, however, from the normal condition in shape, being somewhat long and narrow instead of peculiarly broad. The length is chiefly due to the narrowness and elongation of the ventricle, the apex of which tapers to form a very long and stout gubernaculum cordis attached distally to the pericardium. In connection with the question of shape, it is interesting to note that Rathke* mentions that in embryos of *Chelone* the heart is relatively longer and narrower than in the adult.

The great trunk-veins open into a sinus venosus of moderate size, which in turn opens into the right auricle by a long slit-like orifice the axis of which slopes from below upwards and to the right, and which is guarded laterally by a pair of simple valves. The posterior wall of the sinus venosus is attached by a stout band of splanchnic pericardium containing the coronary vein to the right upper part of the ventricle. A similar band is figured by Fritsch † in the hearts of *Chelhydra serpentina* and *Crocodilus*; and I have seen one in *Testudo indica*, but it is apparently absent in *Chelone*.

The left auricle, as usual, is relatively very small, being not more than a quarter the size of the right. The pulmonary veins unite as they enter it, and their common opening is protected to some extent by a valvular flap, formed by a prolongation of its upper and outer lip into the auricular cavity. As a rule, in the Chelonia the opening of the pulmonary veins into the auricle is not valved in any way.

The interauricular septum is convex towards the left auricle. Its lower edge is thickened and longitudinally split to form a valve for each auriculo-ventricular opening.

The walls of the auricles are very thin in comparison with those of *Chelone mydas* and show little trabecular structure.

The cavity of the ventricle is peculiarly small and scarcely extends half way to the apex. The lower half of the ventricle,

* Rathke: Entwickl. p. 210.

† Fritsch: "Zur vergl. Anat. der Amphibienherzen," Arch. f. Anat. 1869, p 737, pl. 17. fig. 2, and pl. 18. fig. 2.

although to a certain extent trabecular in structure, consists practically of solid muscle. The ventricular septum is quite normal.

The great vessels arise from the ventricle in the usual positions, but it is worth noting that the carotids, 7 cm. above their origin from the innominate artery, suddenly dilate to at least twice their original diameter and then very gradually narrow again towards the head.

The arches of the two aortæ are equal in size—2 cm. in diameter when flattened. They unite on a level with the apex of the ventricle. The cœliac artery arises from the left arch close to its union with the right, the mesenteric from the left side of the upper extremity of the abdominal aorta.

The Veins.

The Renal Portal System (text-fig. 72).—The chief affluent (text-fig. 72, *il.v.*) of the afferent renal vein is formed by the union of a number of small vessels upon the inner side of the ilium. The trunk thus formed runs forward to the hinder end of the kidney, and there divides into two branches—a dorsal one (the afferent renal vein) that runs upon the medio-ventral surface of the kidney, lateral to the ureter, and very soon becomes embedded in the kidney-substance; and a ventral branch that, after taking up the obturator vein, forms one of the roots of the anterior abdominal vein. The latter branch lies upon the dorsal surface of the intra-pelvic muscles, and appears upon the surface of the body-wall in the pubo-epipubic notch. Just in front of the epipubis it unites with its fellow of the opposite side, and the trunk formed by the union runs forward in the substance of the body-wall to the cleft between the ends of the coracoids. Here it receives vessels from the muscles of the left coracoid, then dips down towards the liver and enters it about the middle of the ventral surface of the left lobe. This is the left anterior abdominal vein. The right anterior abdominal vein is represented only by the small vessel formed by the union of the veins from the muscles of the right coracoid. It enters the posterior edge of the isthmus of the liver about its middle, in relatively the same position as the fully developed right anterior abdominal vein of *Emys*.

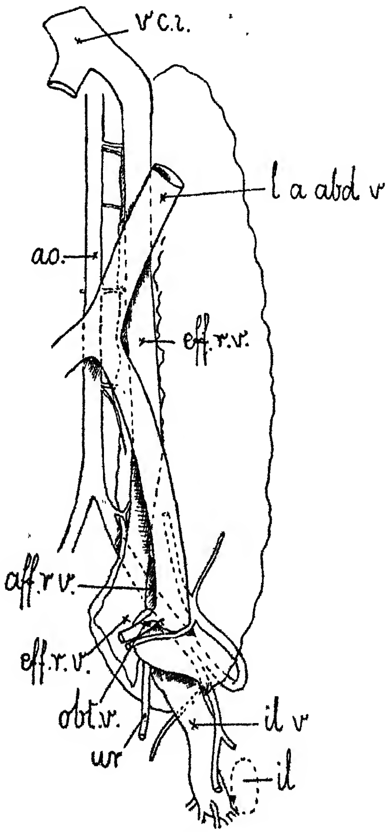
The persistence of only one (the left) anterior abdominal vein, although normal in Amphibia and Lizards, is not the condition generally described as typical of Chelonia, in which (*Testudo, Emys*) both veins persist, forming right and left anterior abdominals. I notice, however, that Rathke* mentions that in young individuals of *Chelone* and in his specimen of *Dermochelys* the left anterior abdominal vein only is present. In *Testudo græca* also

* Rathke: Entwickl. p. 213.

the right anterior abdominal vein may be quite insignificant, not more than a quarter the size of that of the left side.

Within the liver there is an open communication between the anterior abdominal and hepatic portal veins.

Text-fig. 72.



Dermochelys coriacea, left kidney with its associated veins and arteries.

aff.r.v. afferent renal vein, *ao.* aorta, *eff.r.v.* efferent renal vein, *il.* ilium, *il.v.* chief affluent of afferent renal vein, *l.a.abd.v.* left anterior abdominal vein, *obt.v.* obturator vein, *ur.* uretur, *v.c.i.* vena cava inferior.

The efferent renal veins are in no way peculiar. They run forward, one on either side, along the median borders of the kidneys, and at their anterior extremities unite to form the vena

cava inferior. The vena cava lies to the right of the aorta, and enters the deep surface of the right lobe of the liver. Just before leaving the anterior border of the liver, it receives a large hepatic vein.

Two trunks of the hepatic portal system were noted, one coming from the stomach and entering the liver at the anterior end of its left lobe, the other from the first part of the intestine opening into the lower border of the same lobe.

The Thyroid Body.

The thyroid body has the normal position between the roots of the carotid arteries; it is supplied with blood by branches of the subclavians.

ORGANS OF RESPIRATION.

The Larynx.—The larynx closely resembles that of *Chelone*. The procricoid cartilage is not, however, a completely separate nodule, but forms a process of the anterior dorsal border of the crico-thyroid.

The first complete tracheal ring lies 7 cm. behind the anterior margin of the crico-thyroid cartilage. In front of it, included within the crico-thyroid cartilage, there are six imperfect or slightly indicated rings. These, as usual, are more marked and extend further forward on the ventral surface than on the dorsal.

The constrictor and dilator laryngis muscles are quite normal.

The Trachea.—The lower end of the trachea is divided into two lateral channels by a dorso-ventral partition for a distance of 11·5 cm. upwards from the bifurcation of the bronchi. This has been accurately described by Rathke (Müller's Arch. 1846, p. 292).

In this part of the trachea the rings tend to be somewhat irregular and frequently show partial duplication.

RENAL ORGANS.

The kidneys are large and flattened dorso-ventrally. Each measures 23 cm. in length by 11 cm. in breadth at the hinder end, and 6 cm. at the anterior end.

Like the kidneys of other Reptiles they are much lobulated, the lobes having roughly the form of irregular transverse bands, which are themselves further subdivided by close convolutions.

The ureters emerge from the hinder part of the ventral surface of each kidney between the main trunks of the afferent and efferent renal veins, and from this point run directly backwards to the lateral walls of the uro-genital sinus, into which they open upon a pair of prominent papillæ. The walls of the ureters are thick and pigmented.

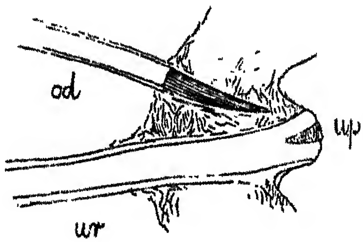
Reproductive Organs.

The ovaries are attached by the parovarium to the dorsal peritoneum just lateral to the efferent renal veins. They are very similar to those of *Chelone*, and, in this young individual, have the form of a flattened band very much folded transversely upon itself. They extend from about 3 cm. behind the posterior end of the kidneys to nearly the same distance in front of their anterior end.

The oviducts, like the ovaries, are in a very immature condition. Each extends from the uro-genital sinus to a point some little distance in front of the ovary, suspended from the dorsal body-wall by a peritoneal fold that passes on anteriorly for some distance beyond the mouth of the duct. The duct does not occupy the free border of the peritoneal fold, but lies about 1 cm. within it; the mouth, however, opens actually upon the free border. The anterior part of the oviduct is slightly wavy.

Posteriorly the oviducts enter the lateral walls of the uro-genital sinus, near the ureters; but on neither side do they in any way communicate with the cavity of the sinus. After an injection of water into both oviducts had failed to show any such opening, the oviducts and ureters were slit up (text-fig. 73). Upon

Text-fig. 73.



Dermochelys coriacea, part of wall of uro-genital sinus, with termination of oviduct and ureter (right side).

entering the wall of the uro-genital sinus, the character of the lining of the oviduct suddenly altered, from being perfectly smooth it became deeply laminate longitudinally. This pleated segment of the duct passed towards the urinary papilla and gradually narrowed to a blind end. Fluid injected down the right ureter entered the uro-genital sinus by two mouths situated on the apex of the urinary papilla. When the ureter was opened it was found that close to the apex of the papilla it forked, each branch being in connection with one of the two openings.

On the urinary papilla of the left side there were also two

openings; but here one only was in connection with the ureter, the other led into a blind pit.

This imperforate condition of the oviducts is probably normal in immature individuals. Professor Stewart has pointed out to me a somewhat similar "hymen" observed by him in a young female Crocodile (*Crocodilus acutus*, R. Coll. Surg. Museum, Physiol. Series, 2725 B), in which the mouth of each oviduct is covered by a delicate membrane.

The cloaca and clitoris closely resemble those of *Chelone*. The cloaca is 25 cm. long. The clitoris is bluntly conical and free at its extremity. It is situated 15 cm. from the external opening of the cloaca.

INDEX.

THE END.

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No. 13.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

January 17th, 1905.

G. A. Boulenger, Esq., F.R.S., Vice-President, in the Chair.

The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of December 1904, and called special attention to a young male Greater Koodoo (*Strepsiceros kudu*) presented by Major Irvine, I.M.S.; to a Hairy-eared Bear (*Ursus piscator*) presented by Mr. Frederick Ringer; to two Victoria Crowned Pigeons (*Goura victoriæ*), obtained by purchase; and to a young specimen of Pousargue's Guenon (*Cercopithecus pousarguei*) presented by Mr. L. Lester. The last-named animal was new to the Collection. The total number of additions during the month was 125.

The Secretary exhibited an enlarged photograph, taken by Mr. H. Sandland and presented by hin to the Society, of "Jim," the Indian Rhinoceros which had recently died in the Gardens after an existence there of forty-one years.

Mr. F. E. Beddard, F.R.S., read the following three papers based on observations he had made on specimens that had died in the Society's Gardens:—(1) Some Notes on the Cranial Osteology of the Mastigure (*Uromastix*); (2) A Contribution to the Anatomy of *Chlamydosaurus* and some other *Agamidæ*; and (3) A Note on the Brain of *Cynopithecus niger*.

In three communications by Mr. W. F. Lanchester, M.A., was given an account of (1) a collection of Sipunculids made at Singapore and Malacca; (2) a collection of Gephyrean Worms from Zanzibar; and (3) the Sipunculids and Echiurids collected

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* This Abstract is published by the Society at 3 Hanover Square, London, W., on the Tuesday following the date of Meeting to which it refers. It will be issued, free of extra charge, to all Fellows who subscribe to the Publications, along with the 'Proceedings'; but it may be obtained on the day of publication at the price of *Sixpence*, or, if desired, sent post-free for the sum of *Six Shillings* per annum, payable in advance.

during the "Skeat Expedition" to the Malay Peninsula. Four new species were described in the second paper and nine in the last.

A communication was read from Mr. A. D. Imms, entitled On the Oral and Pharyngeal Denticles of Elasmobranchs." The Author had found that these denticles were present in varied abundance over the mucous membrane lining both the oral and pharyngeal cavities in many of these fishes. Out of the specimens of the nineteen species (representing eighteen genera) examined, only five, belonging to as many genera, were found to be totally devoid of these structures. In some cases the denticles were uniformly distributed over the whole of the mouth, pharynx, and branchial arches, and this appeared to be the primitive method of distribution. In other forms they tended to disappear from the roof and floor of the mouth and pharynx and became more or less restricted to the branchial arches, or confined almost entirely to the oral cavity. The structure of the denticles proved that they were undoubtedly placoid scales. They did not appear to subserve any definite function, and they were probably to be regarded as vestigial organs.

Dr. C. W. Andrews, F.Z.S., exhibited and made remarks upon the skull of a Musk-Ox from the river-gravels of the Severn Valley at Frampton-on-Severn, near Stonehouse, Gloucestershire. The specimen consisted of the cranial portion of the skull of an old bull, and was found by Mr. W. T. Rennie, of Chepstow, who had presented it to the British Museum. Remains of this species were comparatively rare in Britain, and the nearest previously recorded locality to that described was Barnwood, near Gloucester.

Mr. H. E. Dresser, F.Z.S., exhibited and described three new birds obtained by Col. Waddell, C.B., on the recent expedition to Lhassa, these being the ornithological first-fruits of that expedition, viz.:—

Babax waddelli, nearest to, but differing widely from, *Babax lanceolatus*;

Garrulax tibetanus, a much darker and more uniformly coloured bird than *Garrulax sannio*, with the terminal part of the tail white; and

Lanius lama, a much darker bird than *Lanius schach*, with less white on the forehead, no rufous on the back or scapulars, and no trace of an alar speculum.

The next Meeting of the Society for Scientific Business will be held on Tuesday, the 7th February, 1905, at half-past Eight o'clock P.M., when the following communications will be made:—

1. Mr. NELSON ANNANDALE.—On Abnormal Ranid Larvæ from North-eastern India.

2. Mr. G. A. BOULENGER, F.R.S.—On a Second Collection of Fishes made by Mr. S. L. Hinde in the Kenya District, East Africa.

3. Dr. R. BROOM, C.M.Z.S.—On some Points in the Anatomy of *Diademodon*.

4. Mr. GEORGE L. BATES.—Notes on the Mammals of Southern Cameroons and the Benito.

The following Papers have been received:—

1. Mr. MARTIN A. C. HINTON.—On some Abnormal Remains of *Cervus elaphus* from the Post-Pliocene Deposits of the South of England.

2. Mr. G. A. BOULENGER, F.R.S.—A Contribution to our Knowledge of the Varieties of *Lacerta muralis* in Western Europe and North Africa.

3. Mr. G. T. BETHUNE-BAKER, F.Z.S.—Notes on a small Collection of Heterocera from the Fiji Islands, with Descriptions of some new Species.

4. Mr. R. LYDEKKER.—On Dolphins from Travancore.

5. Mr. R. LYDEKKER.—On the Nigerian and Kilimanjaro Giraffes.

6. Mr. CYRIL CROSSLAND, F.Z.S.—The Œcology and Deposits of the Cape Verde Marine Fauna.

Communications intended for the Scientific Meetings of the ZOOLOGICAL SOCIETY OF LONDON should be addressed to

P. CHALMERS MITCHELL, *Secretary*.

3 HANOVER SQUARE, LONDON, W.
24th January, 1905.

No. 14.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

February 7th, 1905.

Howard Saunders, Esq., Vice-President, in the Chair.

The Secretary exhibited, on behalf of the Hon. Walter Rothschild, F.Z.S., a pair of mounted Gorillas. The animals appeared to be nearly adult and were probably from 12 to 13 years old. The male was unusually red on the head, while the female displayed no trace of this colour. This difference of coloration confirmed Mr. Rothschild's opinion that *Gorilla castaneiceps* of Slack was an aberration and not entitled to specific or subspecific rank.

Mr. Frederick Gillett, F.Z.S., exhibited some mounted heads of the Rocky-Mountain Goat (*Haploceros montanus*), with the object of calling attention to a gland lying at the base of each horn, which he believed had not been previously described.

Mr. R. H. Burne, F.Z.S., exhibited some specimens made from the viscera of the Indian Rhinoceros "Jim" that had lately died in the Society's Gardens.

A communication from Mr. Nelson Annandale contained a description of two abnormal larvæ of the Frog *Rana alticola*.

Mr. G. A. Boulenger, F.R.S., gave an account of a second collection of Fishes made by Mr. S. L. Hinde in the Kenya District of East Africa. Examples of five species were contained in the collection, three of which were new to science.

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A paper was read from Dr. R. Broom, C.M.Z.S., entitled "On some Points in the Anatomy of a Theriodont Reptile."

A communication from Mr. George L. Bates contained field-notes on the Mammals of Southern Cameroons and the Benito.

A communication from Mr. G. T. Bethune-Baker, F.Z.S., contained an account of a collection of Heterocera from the Fiji Islands. Of the species enumerated eleven were new to cience.

Mr. F. E. Beddard, F.R.S., read a paper entitled "A Contribution to the Knowledge of the Arteries of the Brain in the Class Aves."

Mr. Macleod Yearsley, F.Z.S., read a paper on the Function of the Antennæ in Insects. After reviewing the literature on the subject he pointed out that Lowne, in his work on the Blowfly, suggested that the antennæ were probably balancing rather than auditory organs. Lord Avebury and Latreille were cited in favour of this view, and the work of Yves Delage on Crustacea and of Clemens upon a moth (*Samia cecropia*) as confirmatory experiments.

The Author then gave details of experiments upon 30 Wasps (*Vespa vulgaris*) in which the antennæ had been removed. The results of this mutilation were:—1. Loss of power of flight; 2. Loss of sense of direction; 3. Noticeable slowness in all movements. The conclusion arrived at was that, in Wasps, the antennæ were equilibrating in function. This supported Lowne's surmise and corroborated the experiments of Clemens on *Samia cecropia.*

The next Meeting of the Society for Scientific Business will be held on Tuesday, the 21st February, 1905, at half-past Eight o'clock P.M., when the following communications will be made:—

1. Mr. G. A. Boulenger, F.R.S.—A Contribution to our Knowledge of the Varieties of *Lacerta muralis* in Western Europe and North Africa.

2. Mr. R. Lydekker.—On the Nigerian and Kilimanjaro Giraffes.

3. Mr. Cyril Crossland, F.Z.S.—The Œcology and Deposits of the Cape Verde Marine Fauna.

4. Mr. Oldfield Thomas, F.R.S., and Mr. Harold Schwann, F.Z.S.—The Rudd Exploration of South Africa.—II. List of Mammals from the Wakkerstroom District, South-eastern Transvaal.

The following Papers have been received :—

1. Mr. Martin A. C. Hinton.—On some Abnormal Remains of *Cervus elaphus* from the Post-Pliocene Deposits of the South of England.

2. Mr. R. Lydekker.—On Dolphins from Travancore.

3. Dr. R. Broom, C.M.Z.S.—On the Affinities of *Procolophon*.

4. Mr. R I. Pocock.—On the Greater Kudu of Somaliland.

5. Mr. C. Tate Regan, F.Z.S.—A Revision of the Fishes of the South-American Cichlid Genera *Crenacara*, *Batrachops*, and *Crenicichla*.

Communications intended for the Scientific Meetings of the Zoological Society of London should be addressed to

P. CHALMERS MITCHELL, *Secretary*.

3 Hanover Square, London, W.
14*th February*, 1905.

No. 15.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

February 21st, 1905.

HOWARD SAUNDERS, Esq., Vice-President, in the Chair.

The SECRETARY read a report on the additions that had been made to the Society's Menagerie during the month of January 1905, and called special attention to a Red Teetee (*Callithrix cuprea*) from Brazil, representatives of two unknown species of Lemur from Madagascar, a pair of Mouflon (*Ovis musimon*) from Corsica, a Prongbuck (*Antilocapra americana*) from North America, an Ethiopian Wart-Hog (*Phacochœrus æthiopicus*), and two Black-and-White Geese (*Anseranas semipalmata*) from Australia. The total number of additions during the month was 70.

Mr. HENRY SCHERREN, F.Z.S., exhibited, on behalf of Mr. ROWLAND WARD, F.Z.S., a mounted specimen of the Blackbuck (*Antilope cervicapra*). The animal was remarkable for the extent and depth of the dark coloration which covered the whole of the face, obliterating the white eye-patches.

Mr. R. I. POCOCK, F.Z.S., exhibited some specimens of the South-African Millipede (*Spirostreptus pyrocephalus*), presented by Mr. Guthrie, of Port Elizabeth, to the Society's Gardens. These Millipedes had bred in the Gardens.

Mr. G. A. BOULENGER, F.R.S., read a paper entitled "A Contribution to our Knowledge of the Varieties of *Lacerta muralis* in Western Europe and North Africa."

A communication was read from Mr. R. LYDEKKER, F.R.S., on the Nigerian Giraffe (*Giraffa camelopardalis peralta*) and the

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Kilimanjaro Giraffe (*G. camelopardalis tippelskirchi*), based on specimens recently received at the Natural History Museum.

A second communication from Mr. LYDEKKER, on Dolphins from Travancore, was also read. In it the author made special reference to two specimens of the genus *Tursiops*, drawings and particulars of which had been supplied to him from the Trevandrum Museum.

A paper by Messrs. OLDFIELD THOMAS, F.R.S., and HAROLD SCHWANN, F.Z.S., giving an account of a second collection of Mammals made by Mr. C. H. B. Grant for Mr C. D. Rudd's exploration of South Africa, was read.

The collection, which had been presented to the National Museum by Mr. Rudd, was made in the Wakkerstroom district of the South-eastern Transvaal and includes examples of twenty-six species.

Several local subspecies were described, besides the following new Shrew from Zululand:—

MYOSOREX SCLATERI, sp. n.

Allied to *Myosorex varius*, but larger and darker. General colour dark bistre-brown instead of grey.

Dimensions of the type (male):—Head and body 99 mm.; tail 53; hind foot 16; ear 10·5.

Skull: basal length 22; greatest breadth across brain-case 12·5; length of upper tooth-series 10·5.

Hab. Ngoye Hills, Zululand: alt. 250 m.

Type. Male. B.M. no. 4.12.3.12.

Mr. R. I. POCOCK, F.Z.S., read a paper on the Greater Kudu of Somaliland, and pointed out that the northern form of *Strepsiceros strepsiceros* differed from the southern in having only about five white stripes instead of nine or ten on each side of the body. The northern form should thus rank as a distinct subspecies, for which the name *chora* was available. The difference in coloration seemed to be correlated with a difference of habitat, the northern form frequenting more mountainous and less thickly-wooded country than the southern, which was frequently found in the thick jungle along river-banks as well as in the hills.

The next Meeting of the Society for Scientific Business will be held on Tuesday, the 7th March, 1905, at half-past Eight o'clock P.M., when the following communications will be made:—

1. Sir HARRY JOHNSTON, G.C.M.G., K.C.B.—Notes on the Mammals and Birds of Liberia.

2. Mr. CRYIL CROSSLAND, F.Z.S.—The Œcology and Deposits of the Cape Verde Marine Fauna.

3. Mr. C. Tate Regan, F.Z.S.—A Revision of the Fishes of the South-American Cichlid Genera *Crenacara*, *Batrachops*, and *Crenicichla*.

4. Capt. R. Meinertzhagen, F.Z.S.—Notes on a new Oribi Antelope from the Kenya District, British East Africa.

The following Papers have been received :—

1. Mr. Martin A. C. Hinton.—On some Abnormal Remains of *Cervus elaphus* from the Post-Pliocene Deposits of the South of England.

2. Dr. R. Broom, C.M.Z.S.—On the Affinities of *Procolophon*.

3. Dr. E. Lönnberg, C.M.Z.S.—On Hybrids between *Lepus timidus* and *L. europæus* from Southern Sweden.

4. Mr. R. I. Pocock, F.Z.S.—On the Effects of Castration on the Horns of the Prongbuck.

Communications intended for the Scientific Meetings of the Zoological Society of London should be addressed to

P. CHALMERS MITCHELL, *Secretary*.

3 Hanover Square, London, W.
28*th February*, 1905.

No. 16.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

March 7th, 1905.

Dr. W. T. Blanford, C.I.E., F.R.S., Vice-President, in the Chair.

Dr. Albert Gray exhibited a series of lantern-slides in illustration of remarks upon the membranous labyrinth of certain animals.

Mr. Henry Scherren, F.Z.S., called attention to pictures of the Zebra in Aldrovandus (1640) and the 'Commentarius' of Ludolphus (1691). In the course of his remarks he said that in the seventeenth century Zebras (now known as *Equus grevyi*) had been sent by the Ruler of Abyssinia to the Governor of the Dutch East India Company at Batavia, and to the Sultan of Turkey, so that the species was seen in Europe two centuries before the type of *Equus grevyi* reached France in 1882. In proof, passages were cited from Philostorgius Ludolphus, Jean de Thévenot, and other writers.

Mr. G. A. Boulenger, F.R.S., exhibited and made some remarks on a series of spirit-specimens of Fishes from Lake Chad and the Chari River, collected and presented to the British Museum by Capt. G. B. Gosling.

Mr. J. L. Bonhote, F.Z.S., gave an exhibition of hybrid Ducks which had been bred in his aviaries at Cambridge. The crosses exhibited dealt chiefly with four species, of which the following were shown:—

Anas boschas × *A. pœcilorhyncha*,
Anas boschas × *A. pœcilorhyncha* × *Dafila acuta*,
Anas boschas × *A. pœcilorhyncha* × *A. superciliosa*,
Anas boschas × *A. pœcilorhyncha* × *A. superciliosa* × *D. acuta*.

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* This Abstract is published by the Society at 3 Hanover Square, London, W., on the Tuesday following the date of Meeting to which it refers. It will be issued, free of extra charge, to all Fellows who subscribe to the Publications, along with the 'Proceedings'; but it may be obtained on the day of publication at the price of *Sixpence*, or, if desired, sent post-free for the sum of *Six Shillings* per annum, payable in advance.

In describing the various plumages Mr. Bonhote pointed out that the hybrids Mallard (*Anas boschas*) × Spotbill (*A. pœcilorhyncha*) × Pintail (*Dafila acuta*) were divisible into two races, a light and a dark, and also that, whereas in the full-plumaged drakes the Mallard and Pintail characters were chiefly apparent, in the eclipse plumage the characters of the Spotbill supervened. Some curious resemblances to species other than their parents were then noticed, and also characters that could be referred to no known species.

Mr. Bonhote then referred to a paper he had read to the Linnean Society last year, pointing out that colour-variations tended to appear first of all on certain definite parts of the body, and that these parts, to which the name "pœcilomeres" had been given, were common to mammals and birds alike. After treating of this matter at some length, Mr. Bonhote came to the conclusion that, from the study of the birds shown, hybridisation tended to bring about great variation, which followed the lines of the pœcilomeres, and as the result of that variation resemblances were shown towards species which had no part in their parentage.

As illustrating this last statement, a bird (presumably a hybrid between a Wigeon and Pintail) which had been shot wild a short time back was shown. This bird, in addition to the characters of the two parent species, showed on the head markings that might be referred to both the Teal and the New Zealand Duck.

A communication from Mr. Cyril Crossland, F.Z.S., contained an account of the Œcology and Deposits of the Cape Verde Marine Fauna. The Author pointed out that so far as the Cape Verde Group was concerned there was no evidence of any common tropical marine fauna, though certain species were found in both the Atlantic and Indian Oceans. Reef animals were remarkably few in number, the fauna in their place having a considerable subtropical constituent.

Rock simulating coral-rag was formed at the low-tide level by serpulid tubes fused together by *Lithothamnion*, and by the latter and Foraminifera between 5 and 20 fathoms. The absence of reefs might be due in some degree to the remarkably steep coasts of the islands, but it was more especially owing to the extraordinary dominance of boring sponges, worms, and molluscs. Beach sandstone was formed by the deposition of calcareous cement where the fresh water met the salt; it was only found in certain situations, and was everywhere being slowly eroded away by the sea.

Mr. C. Tate Regan, F.Z.S., read a paper entitled "A Revision of the South-American Cichlid Genera, *Crenacara*, *Batrachops*, and *Crenicichla*," in which 23 species were described, 4 of them as new to science.

A communication from Capt. R. Meinertzhagen contained

the following description of a new Antelope from British East Africa:—

OUREBIA KENYÆ, sp. n.

Allied to *O. haggardi*, but with the horns smaller, thinner, and smoother.

Basal length of typical skull 145 mm.; length of horns 136, circumference at base 53.

Hab. Upper Tana River, Mt. Kenya District.

Type. British Museum, No. 4.11.5.28.

The next Meeting of the Society for Scientific Business will be held on Tuesday, the 21st March, 1905, at half-past Eight o'clock P.M., when the following communications will be made:—

1. Sir HARRY JOHNSTON, G.C.M.G., K.C.B.—Notes on the Mammals and Birds of Liberia.

2. Mr. MARTIN A. C. HINTON.—On some Abnormal Remains of *Cervus elaphus* from the Post-Pliocene Deposits of the South of England.

3. Dr. R. BROOM, C.M.Z.S.—On the Affinities of *Procolophon*.

4. Mr. R. I. POCOCK, F.Z.S.—On the Effects of Castration on the Horns of the Prongbuck.

The following Papers have been received:—

1. Mr. A. E. SHIPLEY, F.R.S.—Notes on Parasites from the Zoological Gardens, London, and elsewhere.

2. Dr. E. LÖNNBERG, C.M.Z.S.—On Hybrids between *Lepus timidus* and *L. europæus* from Southern Sweden.

Communications intended for the Scientific Meetings of the ZOOLOGICAL SOCIETY OF LONDON should be addressed to

P. CHALMERS MITCHELL, *Secretary*.

3 HANOVER SQUARE, LONDON, W.
14*th March*, 1905.

No. 17.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

March 21st, 1905.

G. A. BOULENGER, Esq., F.R.S., Vice-President, in the Chair.

The SECRETARY read a report on the additions that had been made to the Society's Menagerie during the month of February 1905, and called special attention to a female Kiang (*Equus hemionus kiang*) deposited by H.M. The King; to a male Lynx (*Felis lynx*) from the Caucasus and a male Leopard of the Persian race (*Felis pardus tulliana*), received in exchange; and to a semi-albino variety of the Common Fox (*Canis vulpes*), received on deposit.

The SECRETARY also read an extract from a letter from Mrs. S. L. Hinde describing the act of a Duiker (*Cephalophus* sp. inc.) killing a Partridge and devouring its head, which it was thought was committed by the animal to gratify its desire for salt.

Mr. FREDERICK GILLETT, F.Z.S., exhibited a photograph of a wounded Oryx (*Oryx beisa*) hiding in undergrowth of wood in its native haunts, in order to show the protective nature of the coloration of the animal.

Mr. C. TATE REGAN, F.Z.S., exhibited and made remarks upon a series of pencil sketches of Fishes of the Rio Negro and its tributaries made by Dr. A. R. Wallace about fifty years ago.

Mr. MACLEOD YEARSLEY, F.Z.S., exhibited a radiograph of a living Snake showing the skeletons of two frogs it had swallowed some hours previously.

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Mr. R. E. Holding exhibited and made remarks upon some skulls of the Fallow Deer (*Dama vulgaris*) and the Red Deer (*Cervus elaphus*) showing arrest of the growth of the antlers due to complete or partial castration.

Mr. R. I. Pocock, F.Z.S., read a paper upon the effects of castration upon the horns of the Prongbuck (*Antilocapra americana*), and pointed out that in a gelded specimen recently deposited in the Gardens the horns formed a semicircular procurvature from the root, ending in a slightly incurved point close beneath the eye; that each horn-sheath, measuring about 9 inches along its convex side, was composite, consisting of six partially severed stunted sheaths; that the "prong," or anterior tyne, was sometimes represented by a small tubercle, but was not present upon all the component sheaths. Hence the effects of the operation were curvature in growth, prevention of exuviation, and practical suppression of the anterior tyne.

Sir Harry Johnston, G.C.M.G., K.C.B., read a paper on the Mammals and Birds of Liberia. He was of opinion that, although Liberia was not marked off clearly by any natural features from either Sierra Leone on the one hand, or the Ivory Coast on the other, it possessed a certain distinctness and a slight degree of peculiarity as regards its flora and fauna. As regards Mammals and Birds, Liberia was, to a great extent, a meeting-place for the forms of Northern Guinea (Sierra Leone to the Gambia) and those of the Gold Coast, the Niger Delta, and the Cameroons. The species of Mammals peculiar to it included the Dwarf Hippopotamus, the Zebra Antelope, Jentink's Duiker, and Büttikofer's Monkey. The author enumerated eighteen species of Mammals and twenty of Birds, specimens of which had been obtained by various collectors in Liberia.

Mr. Martin A. C. Hinton read a paper on Abnormal Remain of the Red Deer (*Cervus elaphus*). The remains consisted of three antlers which were obtained from different Post-Pliocene deposits in the South of England. They agreed in having all the tynes suppressed and in being supported upon very long pedicles, thus resembling in form, though much exceeding in size, those of the Pricket. Rudimentary offsets were seen on the most perfect example, which proved the antler to be the third in the series. These antlers belonged to individuals who had suffered testicular injury at an early period of life, by which the characters of youth were retained for a longer period than was usual.

A paper by Dr. R. Broom, C.M.Z.S., entitled "On the Affinities of *Procolophon*," was communicated by Dr. A. Smith Woodward, F.R.S.

The author believed that Reptiles in Permian times became

specialised along two distinct lines: the one represented by the Pareiasaurians, Anomodonts, Therocephalians, and Theriodonts, and terminating in the Mammals; the second giving rise to all the other reptilian orders. The common ancestor was believed to have been a true reptile probably belonging to the order Cotylosauria. *Procolophon* was held to be an early member of the branch which led to the Rhynchocephalians, and possibly fairly closely allied to the land ancestor of *Mesosaurus*.

Professor H. G. Seeley, F.R.S., described the skulls of the Fossil Reptile *Procolophon* from Donnybrook and Fernrocks. He considered that the bone hitherto regarded as quadrato-jugal was the quadrate bone, which was embedded in the squamosal and sent a strong thin process inward above the pterygoid. The size of the posterior process of the quadrate was a character distinguishing species. There was no postorbital foramen in several species; it attained its maximum in *Procolophon laticeps*. The occipital region was closed and projected beyond the squamosal and quadrate bones. The molar teeth had inner and outer cusps. The fore and hind limbs were also described. The author concluded that the main affinities were with the Anomodontia, chiefly with the Pareiasauria, and in the teeth with the Theriodontia; but that in a less degree there were indications of affinity with Reptiles classed as Labyrinthodonts. All parts of the skeleton supported the separation of the Procolophonia as an order of extinct Reptilia.

The next Meeting of the Society for Scientific Business will be held on Tuesday, the 18th April, 1905, at half-past Eight o'clock P.M., when the following communications will be made:—

1. Mr. A. E. Shipley, F.R.S.—Notes on Ento-Parasites from the Zoological Gardens, London, and elsewhere.

2. Dr. E. Lönnberg, C.M.Z.S.—On Hybrids between *Lepus timidus* and *L. europæus* from Southern Sweden.

3. Mr. R. H. Burne, F.Z.S.—Notes on the Muscular and Visceral Anatomy of a Leathery Turtle (*Demochelys coriacea*).

The following Papers have been received:—

1. Prof. E. A. Minchin, F.Z.S.—On *Leucosolenia contorta* Bowerbank, *Ascandra contorta* Haeckel, and *Ascetta spinosa* Lendenfeld.

2. Mr. A. L. Butler, F.Z.S.—On the Giant Eland of the Bahr-el-Ghazal (*Taurotragus derbianus gigas* Heugl.).

3. Mr. F. E. BEDDARD, F.Z.S.—Some Notes upon the Anatomy of the Ferret-Badger (*Helictus personatus*).

4. Messrs. OLDFIELD THOMAS, F.R.S., and HAROLD SCHWANN, F.Z.S.—The Rudd Exploration of South Africa. III. List of the Mammals obtained by Mr. Grant in Zululand.

Communications intended for the Scientific Meetings of the ZOOLOGICAL SOCIETY OF LONDON should be addressed to

P. CHALMERS MITCHELL, *Secretary.*

3 HANOVER SQUARE, LONDON, W.
28*th March*, 1905.

No. 18.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

April 18th, 1905.

HERBERT DRUCE, Esq., F.L.S., Vice-President, in the Chair.

The SECRETARY read a report on the additions that had been made to the Society's Menagerie during the month of March 1905, and called special attention to an Eland and a Bactrian Camel, born in the Gardens; to a Brush-tailed Pouched Mouse (*Phascogale penicillata*), a Greater Bird-of-Paradise (*Paradisea apoda*) and two Lesser Birds-of-Paradise (*P. minor*), received on deposit; and to a Black Lory (*Chalcopsittacus ater*) obtained by purchase. The total number of additions during the month was 148.

Mr. J. G. MILLAIS, F.Z.S., exhibited the horn-core (with sheath attached) of an Urus (*Bos primigenius*). The specimen was believed to be the only British example of the actual horn of the Urus in existence. The curious corrugations on the surface of the lower end were similar to those found on the American and European Bison, and incidentally supported the view that the White Cattle of Chillingham, Chartley, and Cadzow were not descended from this animal.

The SECRETARY exhibited, on behalf of Mr. OLDFIELD THOMAS, F.R.S., a photograph of the horns of a Roberts's Gazelle (*Gazella grantii robertsi*) which had been obtained by Mr. C. L. Chevalier, Medical Officer to the Anglo-German Boundary Commission.

Dr. W. J. HOLLAND, F.Z.S., Director of the Carnegie Museum and Institute, Pittsburg, U.S.A., gave an account, illustrated by stereopticon slides, of the discovery of the skeleton of *Diplodocus carnegii* Hatcher, a reproduction of which he was at present

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installing in the Gallery of Reptiles at the British Museum (Natural History), South Kensington.

After paying tribute to the generosity of Mr. Andrew Carnegie, who had supplied the funds necessary for the extensive explorations which were being carried on by the Carnegie Institute, under the direction of the speaker, he went on to speak of the Geology of Wyoming and of the immediate locality, where the specimen was obtained. He incidentally described the methods employed by American collectors to secure vertebrate fossils in fine condition. He then discussed the osteology of *Diplodocus*, briefly pointing out some of the more interesting structural features of the skeleton, and in this connection animadverted upon certain so-called "restorations" made public in popular magazines and emanating from artists whose artistic ability was quite in excess of their scientific knowledge.

Dr. Holland concluded his account by exhibiting in rapid succession pictures of a few of the more remarkable skeletons which had been recovered by the palæontological staff of the Carnegie Museum from various localities in the region of the Rocky Mountains.

Dr. Smith Woodward, F.R.S., read a paper on a unique specimen of *Cetiosaurus leedsi*, a Sauropodous Dinosaur from the Oxford Clay of Peterborough. He described the fore and hind limbs and the tail, and confirmed the observation of the late Prof. O. C. Marsh, that *Cetiosaurus* was one of the more generalised Sauropoda.

The Secretary read a short paper entitled "On a Young Female Nigerian Giraffe." On the evidence afforded by a young female giraffe, obtained by Captain Phillips in the district of Gummel, about 300 miles due west of Lake Chad, and now deposited in the Society's Gardens, he was inclined to believe in the distinctness of the Nigerian Giraffe (*Giraffa camelopardalis peralta* of Thomas), which, however, was closely allied to the Nubian form (*G. c. typica*).

A communication was read from Mr. A. E. Shipley, F.R.S., dealing with the Ento-Parasites he had obtained from the Zoological Gardens, London, and elsewhere. Thirteen species were enumerated, one of which was described as new.

Mr. R. H. Burne, F.Z.S., read a paper descriptive of the muscular and visceral anatomy of a Leathery Turtle (*Dermatochelys coriacea*). The animal was a young female about four feet long, and was thus considerably larger than the few examples of this rare Chelonian that had previously been dissected. It came from Japan. The muscles of the neck, trunk, and limbs were described in detail, and notes were made of numerous hitherto unrecorded or imperfectly described features of the alimentary and other internal organs.

Mr. HAROLD SCHWANN, F.Z.S., read a paper, prepared by Mr. OLDFIELD THOMAS, F.R.S., and himself, which gave an account of a third collection of Mammals made by Mr. C. H. B. Grant for Mr. C. D. Rudd's Exploration of South Africa, and presented by the latter gentleman to the National Museum.

The present series was obtained in Zululand, and consisted of 222 specimens, belonging to 49 species, of which several were described as new, besides a number of local subspecies.

Of the new forms, the following were the most noticeable:—

AMBLYSOMUS IRIS, sp. n.

Allied to *A. hottentottus*, but much smaller. Colour smoky blackish above and below.

Dimensions of the type:—Head and body 116 mm.; hind foot 13. Greatest length of skull 25·4.

Hab. Umvolosi Station, Zululand. *Type.* B.M. No. 4.12.3.9.

OTOMYS LAMINATUS, sp. n.

Allied to *O. irroratus*, but with 9 laminæ on the last upper molar and 7 on the anterior lower.

Dimensions of the type:—Head and body 180 mm.; tail 120; hind foot 22. Basilar length of skull 35.

Hab. Sibudeni, Zululand. *Type.* B.M. No. 4.5.1.45.

PRONOLAGUS RUDDI, sp. n.

Allied to *P. crassicaudatus*, but considerably larger and with coarser fur. Palatal foramina narrowed and sharply edged behind.

Dimensions of the type:—Head and body 482 mm.; tail 52; hind foot 99; ear 98. Greatest length of skull 92.

Hab. Sibudeni, Zululand. *Type.* B.M. No. 4.5.1.78.

A communication from Mr. G. A. BOULENGER, F.R.S., contained a description of a new species of Newt from Yunnan.

The SECRETARY read, on behalf of Dr. EINAR LÖNNBERG, C.M.Z.S., a paper on hybrid Hares between *Lepus timidus* Linn. and *L. europæus* Pall., in Southern Sweden. The hybrids had become comparatively common in this part of Sweden owing to the introduction of the latter species for hunting purposes.

A communication from Mr. A. L. BUTLER, F.Z.S., contained a description of the Giant Eland of the Bahr-el-Ghazal. Mr. Butler was of opinion that this Eland was more nearly allied to the West African form than to that of South Africa, and proposed to distinguish it as *Taurotragus derbianus gigas*. It differed from the typical *T. derbianus* in its much lighter body-colour (a pale "café-au-lait" fawn instead of a rich ruddy brown), in the greyish white of the black-maned dewlap, and in carrying grander horns.

The next Meeting of the Society for Scientific Business will be held on Tuesday, the 2nd May, 1905, at half-past Eight o'clock P.M., when the following communications will be made :—

1. Prof. E. A. Minchin, F.Z.S.—On *Leucosolenia contorta* Bowerbank, *Ascandra contorta* Haeckel, and *Ascetta spinosa* Lendenfeld.

2. Mr. F. E. Beddard, F.R.S.—Some Notes upon the Anatomy of the Ferret-Badger (*Helictis personata*).

3. Mr. W. P. Pycraft, F.Z.S.—Contributions to the Osteology of Birds.—Part VII. *Eurylæmidæ*, with Remarks on the Systematic Position of the Group.

The following papers have been received :—

1. Mr. F. E. Beddard, F.R.S.—A Contribution to the Knowedge of the Encephalic Arterial System in Sauropsida.

2. Dr. E. Bergroth, C.M.Z.S.—On Stridulating *Halyinæ*, with Descriptions of new Genera and Species.

Communications intended for the Scientific Meetings of the Zoological Society of London should be addressed to

P. CHALMERS MITCHELL, *Secretary*.

3 Hanover Square, London, W.
25th April, 1905.

(42)2